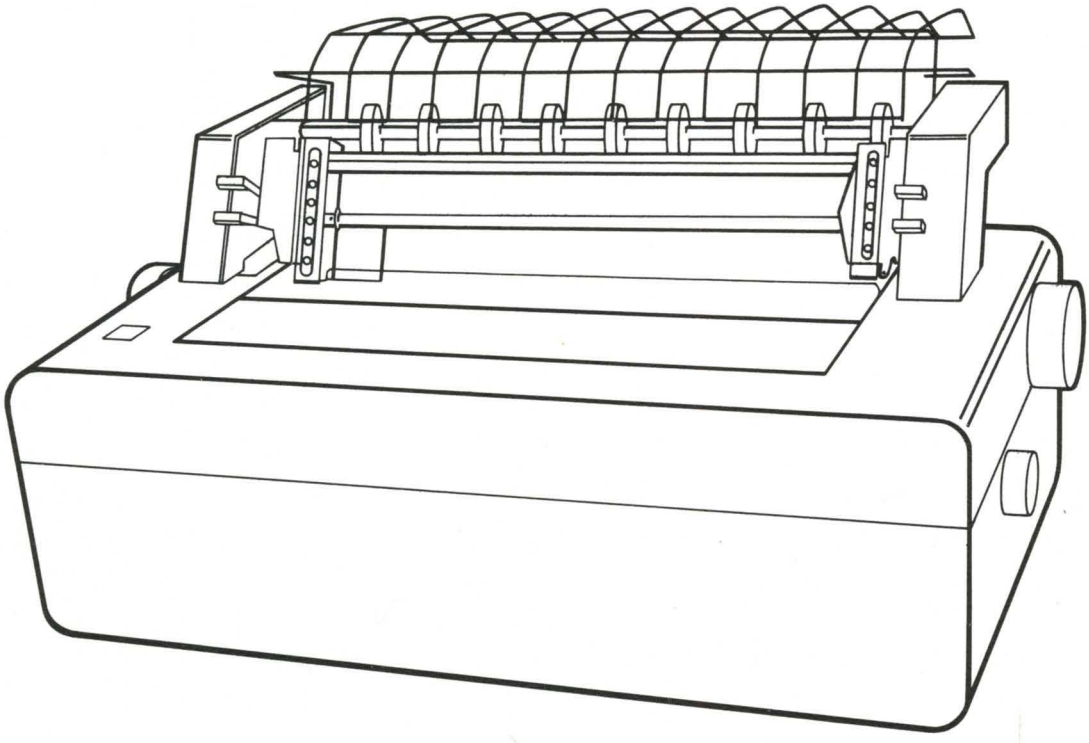
IBM

Series/1

GA34-0025-1

File No. S1-03

IBM Series/1
4974 Printer
Description



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Second Edition (March 1977)

This is a major revision of, and obsoletes GA34-0025-0. Significant changes in this new edition include:

Restructuring of status words
Changing the format of data flow information

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Contents

Preface

This manual contains reference material and is a source of information about the IBM Series/1 4974 Printer, and the 4974 Printer Attachment Feature.

Chapter 1 is an introduction to the general characteristics and features of the 4974.

Chapter 2 discusses the data flow between the processor and the 4974. Specific topics are:

- I/O Commands
- I/O Operations
- Status Information

Appendix A contains EBCDIC characters and hexadecimal equivalents.

Appendix B contains information on printer forms.

Appendix C contains information on building a Wire Image table.

Prerequisite Knowledge

This book assumes the reader has a background in data processing and is familiar with the hexadecimal numbering system as used in IBM systems. It is assumed the reader has a basic understanding of printers and their relationship to a processor and an understanding of stored program concepts.

Prerequisite Publications

IBM Series/1 Model 5 4955 Processor and Processor Features Description, GA34-0021

IBM Series/1 Model 3 4953 Processor and Processor Features Description, GA34-0022

IBM Series/1 System Summary, GA34-0035

Related Publications

IBM Series/1 Installation Manual–Physical Planning, GA34-0029-1

IBM Series/1 Configurator, GA34-0042

IBM Series/1 Operator's Guide, GA34-0039

Chapter 1. Introduction

The IBM Series/1 4974 Printer (Figure 1-1) is a table top wire matrix printer that produces characters printed by a pattern of dots, and provides medium speed output for the IBM Series/1.

The printer connects to the attachment card (a prerequisite for the 4974 printer) which is located in one of the following rack mounted units:

- IBM Series/1 Model 5 4955 Processor
- IBM Series/1 Model 3 4953 Processor
- IBM Series/1 4959 Input/Output Expansion Unit

Printer Functional Description

The IBM 4974:

- Is a wire matrix printer controlled by a cycle stealing attachment
- Performs bi-directional printing (the print head prints while moving left to right or right to left)
- Operates at 120 characters per second (cps)
- Prints up to 132 characters per line (cpl)
- Prints 10 characters per inch (cpi) with a maximum line width of 33.5cm (13.2 in.)
- Prints 6 lines per inch (lpi)
- Spaces with a maximum of 84 lines per command
- Can skip to any line on the form
- Suppresses unprintable characters
- Uses the EBCDIC (Extended Binary Coded Decimal Interchange Code) 64-character set (See Appendix A, "EBCDIC Character–Hexadecimal Equivalent Codes")
- Has a Forms Tractor that accepts up to 6-part, cut, multicut, continous or margin punched forms

The printer speed is based upon the number of single spaced lines that can be printed per minute. Approximate speeds are:

Characters per line	*Lines per minute*
34	150
45	122
70	86
90	69
132	49

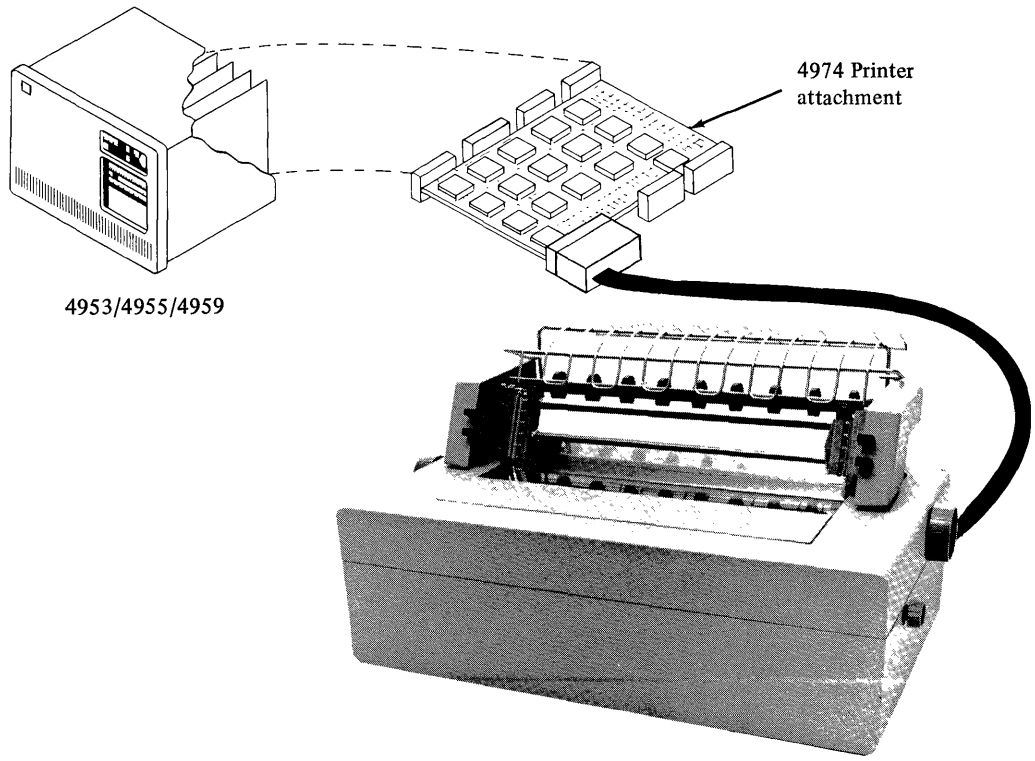


Figure 1-1. IBM Series/1 4974 Printer and attachment card

Attachment Feature Functional Description

The attachment feature card:

- Serves as the connection between the processor and printer
- Transfers characters from processor storage to the printer
- Converts the processor storage characters into a printable dot matrix
- Contains a wire image buffer used in generation of the dot matrix
- Controls form movement (see note)

Note. The using system's program can define, through the attachment, the length of the forms and the overflow line on the form.

Standard Features

Cycle Steal

The 4974 operates in *cycle steal* mode. In cycle steal mode the I/O operations are overlapped with processing operations, so that processing can continue while I/O operations are in progress.

Character Set

The printer uses the EBCDIC 64-character set, however, the attachment will accept any 8-bit character code (defined and selected by the user and user alterable) and print up to a 96-character set. The 4974 has the ability to self initialize the basic character set. For other than the standard character set, refer to Appendix A, "EBCDIC Character Hexadecimal Equivalents" and Appendix C, "Wire Image Table."

Basic Components

The 4974 Printer consists of two basic components:

- Printer
- Forms Tractor Unit

Printer

The printing operation, moving the printhead and printing dots, is controlled entirely by the attachment. Characters are formed by printing a pattern of dots in a vertical arrangement that corresponds to a stored matrix in the Wire Image Buffer of the attachment. The character-pattern matrix used by the printer is 8-high by 7-wide.

When a character is to be printed, the printhead moves horizontally across the paper, along the print line, while selectively firing the print wires against the ribbon to make the dots. Figure 1-2 shows a side view of the printhead and an end view of the wire guide. The printhead has eight print wires arranged vertically. As the printhead moves across the line a character is formed by printing a pattern of dots. Figure 1-3 illustrates how the character "A" is formed.

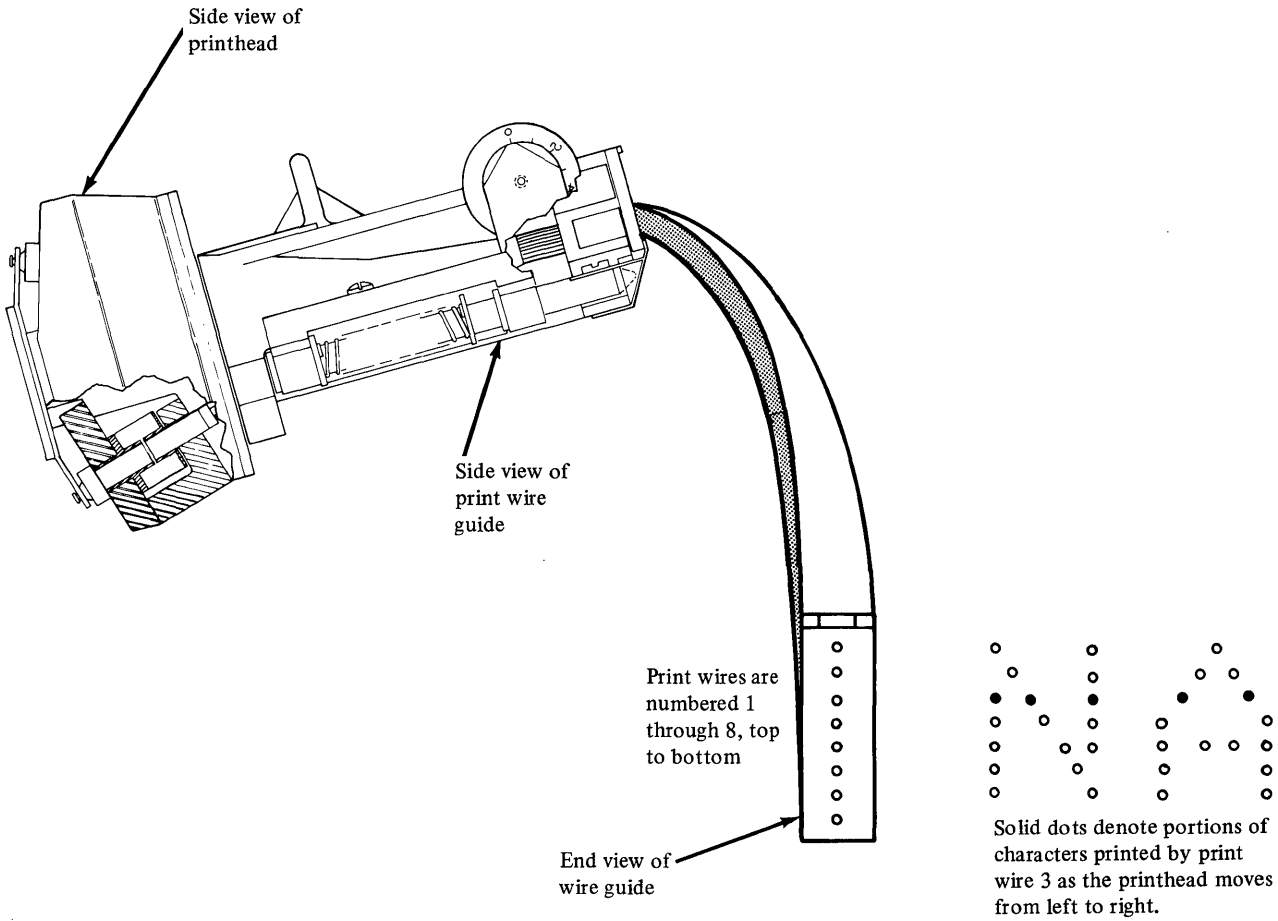
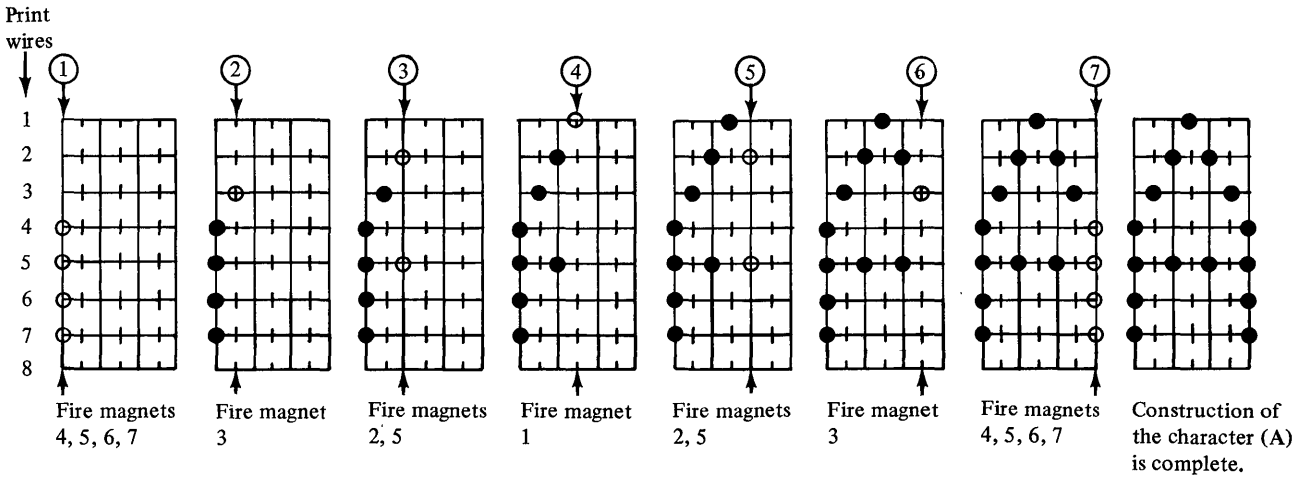


Figure 1-2. Printhead and printwires



This illustrates how the character A is formed by firing a combination of 7 print wires within a matrix (a character position). The numbers of the print wires are shown at the far left. The sequence of firing positions, within the matrix is shown from left-to-right across the page. Note that no magnet is fired in successive firing positions.

Figure 1-3. Printing a character in a print position

Forms Tractor Unit

The Forms Tractor (Figure 1-4) is that portion of the printer which causes movement of the installed forms. The Forms Tractor is required for printing on multiple part continuous forms or preprinted continuous forms. The unit snaps into place on top of the printer frame and can be pivoted back out of the way when cut forms are to be used. The right and left tractors on the unit are adjustable to handle different size paper. (See Appendix B, "Printer Forms" for more information concerning paper size.)

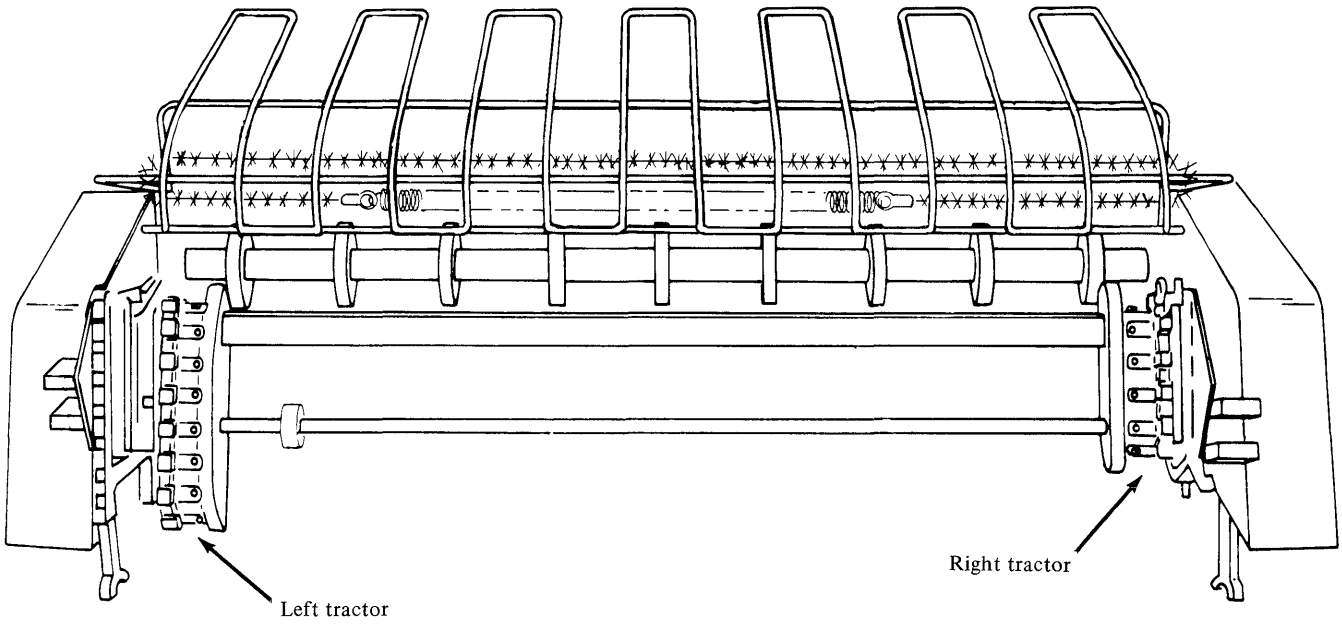


Figure 1-4. Forms tractor unit

Controls

The printer has several controls for moving and adjusting paper and forms. (See Figure 1-5 for locations of the controls.) There are two switches located on the printer, one for powering the unit and the other for servicing. They are:

- Power switch
- Mode switch

Power Switch

The Power Switch is used for powering the printer on/off.

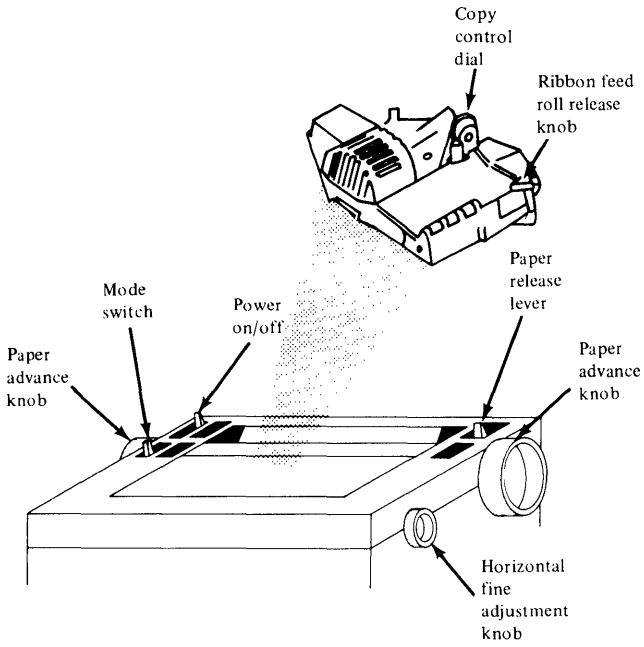


Figure 1-5. Printer controls

Mode Switch

The Mode switch is in front of the Power Switch and has three positions:

- Print
- Wait
- Top of Forms

For normal operation the switch should be in the Print position.

Print. In this position, the printer is available for execution of system commands. If no system commands are issued within approximately a 6-second period, the attachment moves the printhead to the extreme left position.

When the printer has been in the Wait state and then moves to the Print state, the attachment corrects the print head to the print position.

Wait. In this position, the printer is no longer available for executing system commands. The current command is completed and all printer action is stopped. Once the current command is completed, the printer will ignore any forms or print head movement. In this position, forms can be moved manually for alignment.

Top of Forms. In this position, the attachment will set the positions of the forms to line one. As long as the switch is in this position, the forms position will be line one regardless of manual forms movement. This allows for alignment to the top of the form.

Note. For detailed descriptions of all printer operator controls, refer to the *Series/1 Operators Guide,* GA34-0039.

Chapter 2. Programming Input/Output Operations

This chapter discusses the flow of data to and from the printer. Specific topics are commands, status information and I/O Instructions.

Data Transfer Operations

Data is transferred between the processor and the attachment, in a parallel operation (16 data bits plus 2 parity bits). The number of data words transferred and the direction in which they move is determined by the I/O command. The I/O command also determines whether data is transferred to or from processor storage, under Direct Program Control (DPC) only, or under Direct Program Control and in Cycle Steal (CS) mode.

Direct Program Control (DPC)

Under direct program control, only one word of data moves to or from processor storage at a time. After moving the data, the processor continues processing other instructions. Moving data under DPC does not cause interrupts.

Cycle Steal

When data is moved to or from processor storage by stealing storage cycles (Cycle Steal mode), processing and I/O operations are overlapped. Overlapping multiple data transfers allow the processor to execute other instructions while the printer is performing I/O operations.

Initiating a Printer Operation

Every input/output operation to the 4974 requires (in processor storage):

1. An Operate I/O instruction
2. An I/O command, device address, an immediate data field

Operate I/O Instruction

The following description is an overview of the Operate I/O instruction. Refer to the Processor Description Manuals listed in the "Prerequisite Publications" section of the Preface for a more detailed description.

All input/output operations from the processor to the printer, are initiated by an Operate I/O Instruction. An address field (bits 16–31) and the R2 field (bits 8–10) in the Operate I/O instruction (Figure 2-1) point to a processor storage location containing an IDCB (Immediate Device Control Block). The IDCB is a two-word block of storage, that contains the device directed I/O commands. Before issuing the I/O instruction for an operation, the command field of the IDCB (Bits 0–7) must be set, along with a device address (bits 8–15), and any field of immediate data required by the command in the IDCB (bits 16–31). The information specified in the immediate field depends on the command to be performed. The device address of the 4974 can be one of 128 (0–127) possible device addresses. This address is determined by the Device Address Field of the IDCB. Bit 8 of this field must be zero.

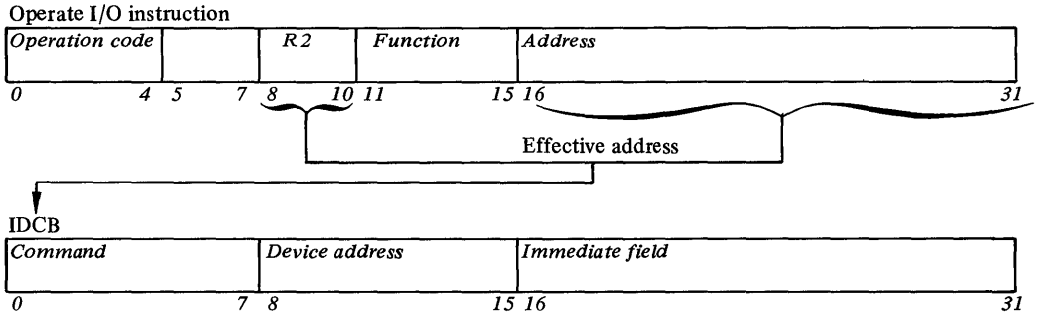


Figure 2-1. Operate I/O Instruction

Using the IDCB

An Immediate Device Control Block (IDCB) is required for every I/O command issued to the printer. The format of the IDCB is shown in Figure 2-2. Before issuing an I/O instruction, an I/O command must be stored in the associated IDCB. The immediate data field of the IDCB should contain either a data word or a DCB address. I/O commands that execute under direct program control require a data word, while the commands that execute in cycle steal mode require a DCB address.

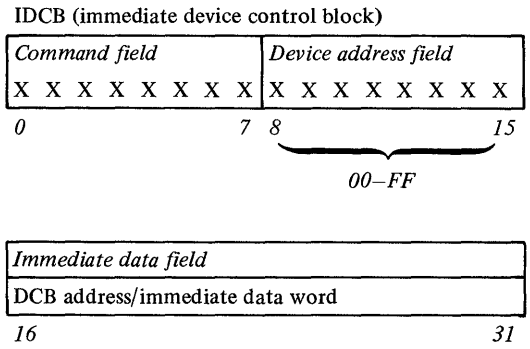


Figure 2-2. IDCB format

Input/Output Commands and Printer Operations

The I/O command, stored in the IDCB, determines whether a single word of data is transferred under direct program control only or following a direct program control operation, additional words of data are to be transferred to the processor under cycle steal mode. The 4974 responds to the following I/O commands (defined in the command field (bits 0–7) of the IDCB):

Direct Program Control (DPC)

1. Prepare
2. Device Reset
3. Read Device ID

Cycle Steal Mode (CS)

1. Start
2. Start Cycle Steal Status

Command Execution Under DPC Mode

When the printer executes a Prepare, Device Reset, or Read ID command, a word of data is moved to or from the immediate data field of the IDCB in processor storage. These commands do not cause interrupts. After execution of the command, the 4974 reports a condition code that indicates whether the I/O operation succeeded or failed. See "Condition Codes" later in this chapter. Processing operations are halted while the I/O operation is in progress. Figure 2-3 shows command execution under DPC mode.

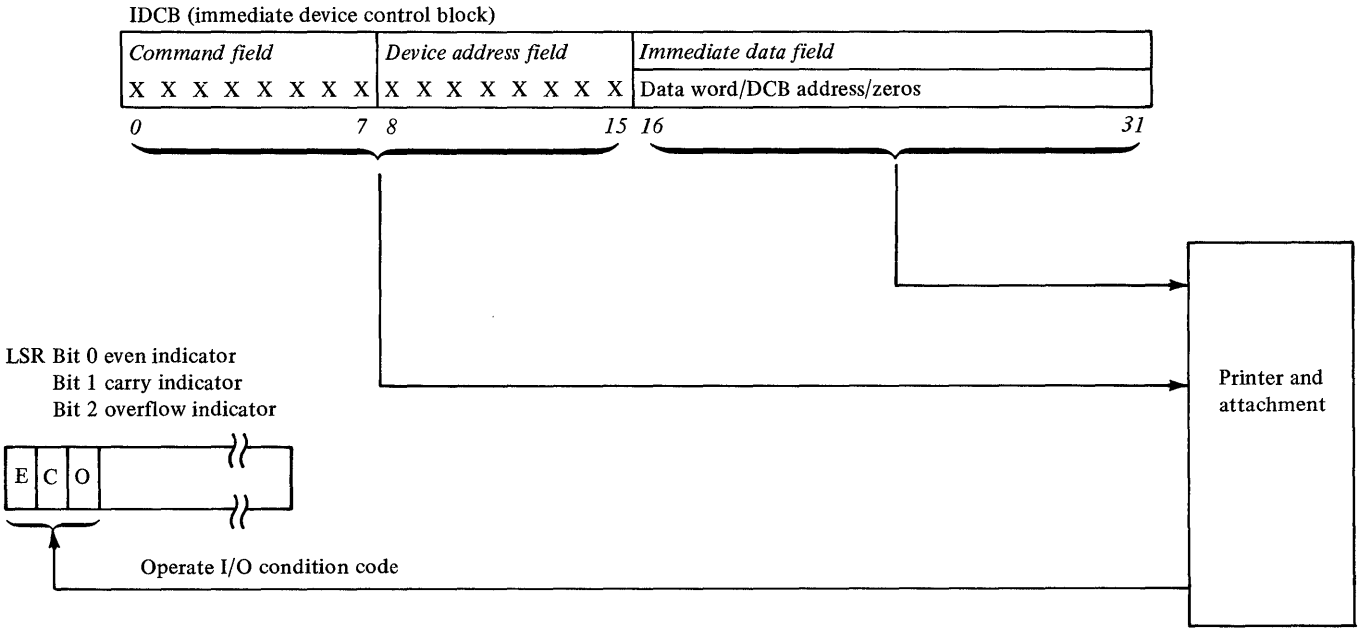
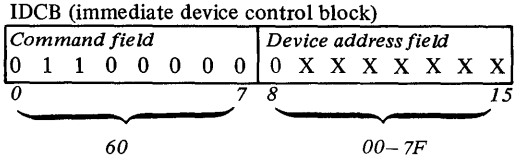


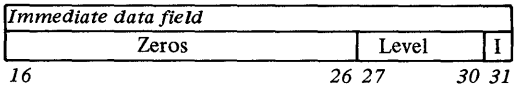
Figure 2-3. Command execution under DPC

Prepare Command

Before the printer can execute interrupt causing commands, it needs interruption parameters. These parameters, stored in the IDCB immediate field associated with a Prepare command, contain the level on which the attachment is to interrupt (bit 27–30), and an interrupt enable (bit 31). These bits are transferred to the attachment upon execution of Prepare commands. If the I-bit (bit 31) equals 1, the printer can interrupt. If the I-bit equals 0, it cannot.
The Prepare command operates under DPC and does not cause an interrupt.

IDCB (immediate device control block)





Device Reset

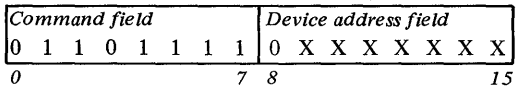
A Device Reset command will:

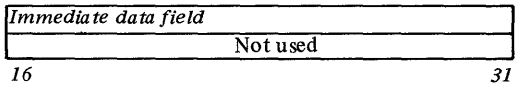
- Halt any Start command
- Stop all cycle stealing, printing and carriage movement
- Reset Control, Status and Pending interrupts
- Reset the ISB
- Restore the printhead to the left margin

The command code and device address supply all needed information. Although the immediate data field is not used or checked, these bits should be set to zero. The Device Reset command operates under DPC and does not cause an interrupt.

Note. If the carriage was moving at the time of the Device Reset command execution, the forms may have to be realigned.

IDCB (immediate device control block)

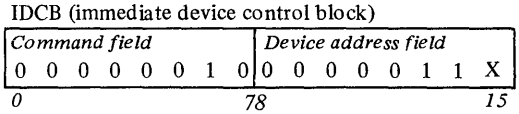


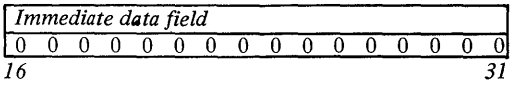


Read Device ID

The Read Device ID command transfers the device ID word for the printer into the immediate field of the Immediate Device Control Block (IDCB) associated with that command. If the printer is busy or an interrupt is pending, condition code 1 is returned. The Read Device ID command operates under DPC and does not cause an interrupt.

IDCB (immediate device control block)

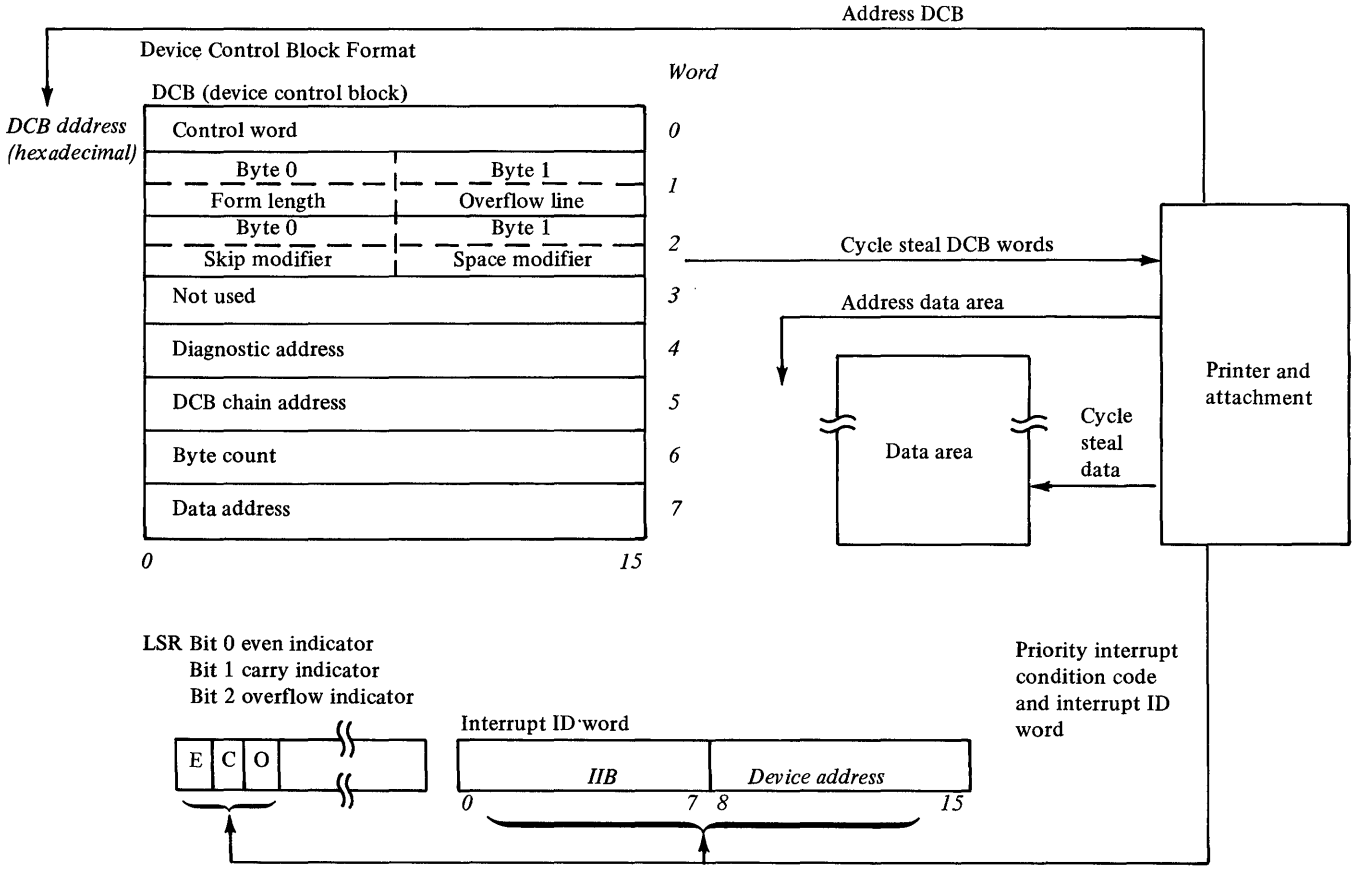




Command Execution in CS Mode

The Start command and the Start Cycle Steal Status command are interrupt-causing commands, and move data under both direct program control and cycle steal mode. When the attachment receives and accepts either of these commands, it reports a condition code to the processor and begins command execution. The processor continues with other operations while the attachment is "busy" with the I/O operation. When the I/O operation is completed, the attachment sends an interrupt request to the processor. At interrupt presentation time the attachment reports a condition code and transfers an interrupt identification word containing status information to the processor. See "I/O Status Information" later in this chapter.

The immediate data field of an IDCB containing either a Start command or a Start Cycle Steal Status command must point to a Device Control Block (DCB). The DCB must contain the control information and device parameters that are required to execute an I/O operation in cycle steal mode. Figure 2-4 shows command execution in CS mode.

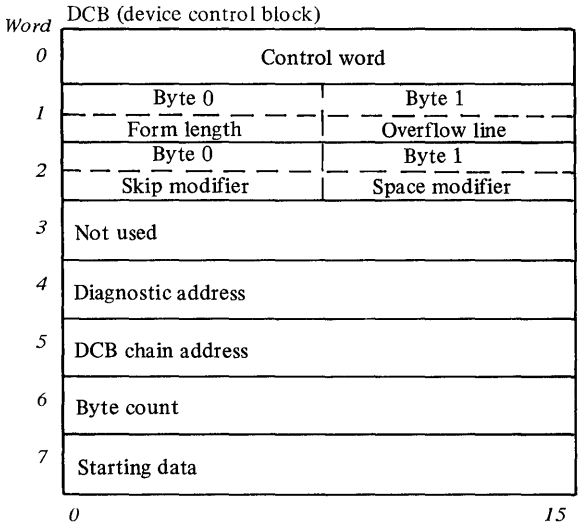


Note. DCB format is shown for a start command. The DCB format for a start cycle steal status command appears later in this chapter.

Figure 2-4. Command execution in cycle steal mode

Using the DCB

A Device Control Block (DCB), comprised of eight contiguous words in processor storage, must be reserved for every I/O operation that moves data in cycle steal mode. All Start commands, Start Cycle Steal Status commands, and all printer operations included in a DCB command chaining sequence require a separate DCB. Device parameters that define and control the I/O operation must be stored in each DCB.



Note. Word 3 of the DCB Table is accessed but not used.

DCB Format

The following text will describe the bit significance of each of the eight contiguous data words in the DCB.

Control Word—DCB Word 0

The control word is the first word of the DCB. It is a 16-bit word that explains the cycle stealing operation, and contains two distinct bytes of control parameters to be used with the particular Start command to be performed. Figure 2-5 shows the DCB and Control Word 0.

DCB Word 0—Control Word

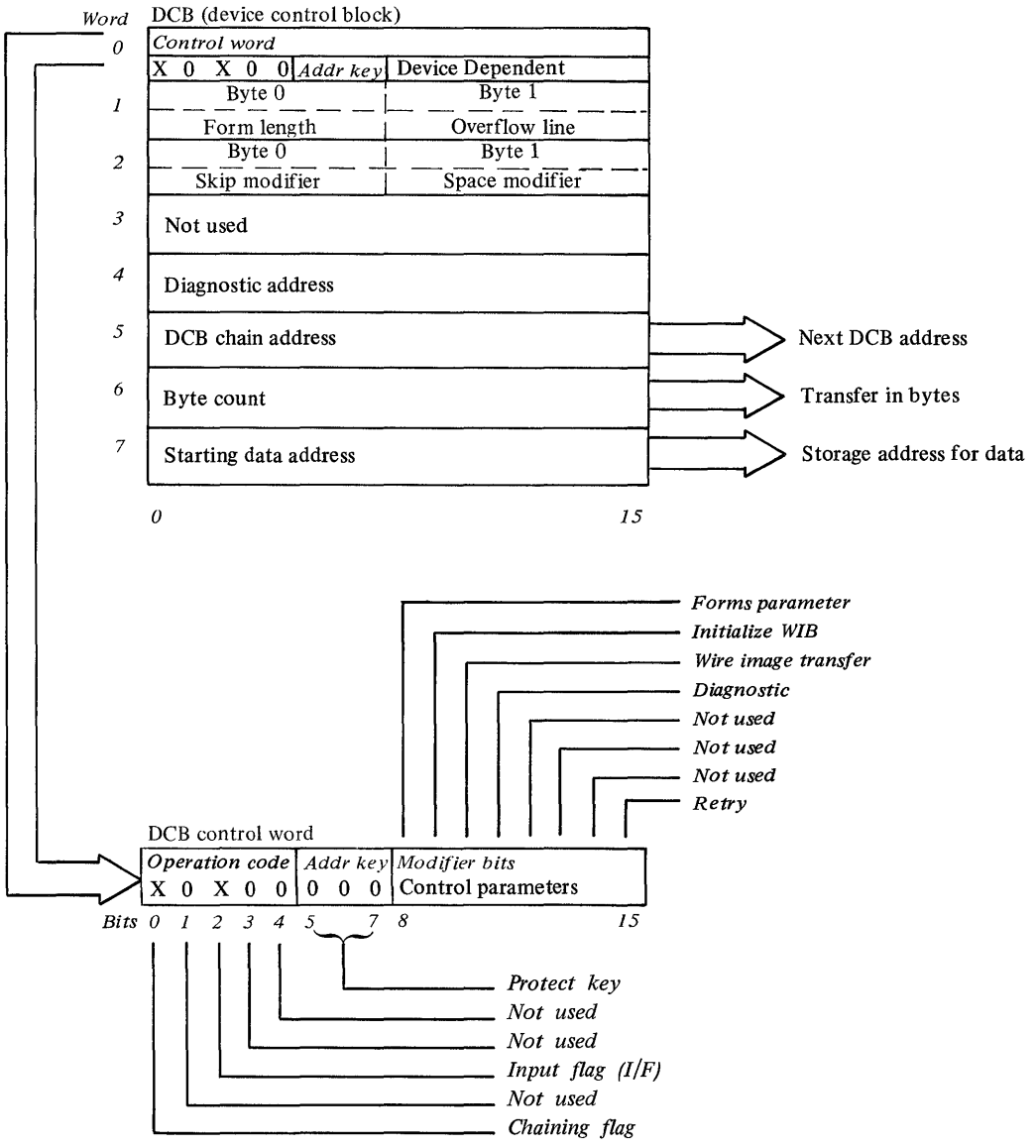


Figure 2-5. DCB and it's control word

Bits 1, 3 and 4 of the control word are not supported and should be zero.

Bit 0–Chaining Flag

This bit when = to 1, indicates a command chaining operation. After completing the current DCB operation, the attachment will not interrupt but will fetch the next DCB pointed to by the Chain Address in DCB word 5. Command Chaining is valid only for a Start I/O command. It is ignored and not checked for by the other commands.

Bit 2–I/F (Input Flag)

This bit indicates the direction of the cycle steal data transfer: 0 = out of processor storage, 1 = into processor storage.

Bits 5, 6 and 7–Address Key

This is a 3-bit key presented by the attachment during data transfers to ascertain storage access authorization. An incorrect Address key will cause an exception interrupt.

Bits 8 thru 15 (the second byte of the control word) are device dependent.

Bit 8–Forms Parameter Bit

This bit is an indicator telling whether forms parameters are available in the DCB. If this bit = 0, word 1 of the DCB is not used. If this bit = 1, word 1 of the DCB contains new forms parameters.

Byte 0 = the number of lines on one form (form length). This can be a value of 1 to 255. Zero is invalid and sets an interrupt with a specification check in the Interrupt Status Byte. See "Interrupt Status Byte" later in this chapter. Byte 1 contains the line where the overflow interrupt is desired and can occur only once per form. The first time an overflow line is reached, the forms stop and no printing occurs. The attachment gives an exception interrupt with bit 0 on in the ISB, and sets an overflow bit in cycle steal status word 1. This interrupt can be used to skip over the folds on forms and to print trailers or headers on forms. Bits 9, 10, and 11 are mutually exclusive. If more than one of these bits are detected in the same DCB control word, an exception interrupt with a DCB specification check is reported. For printing to take place, bits 9, 10 and 11 must be zero.

The printer provides the facility to load the wire image buffer with the standard 64-character EBCDIC set, to overlay some of these characters with special characters and symbols, or for the system user to load his own character set. Bits 9 and 10 control the selection of these facilities.

Initialization of the Wire Image Buffer must take place in order for printing to take place. Power on reset initializes the wire image buffer with the standard 64 character U.S. EBCDIC set. If other than the standard character set is to be used, the wire image buffer must be altered after power on reset using bits 9 or 10.

The character set identifying bits for the 4974 are: 0000000000000000 (eight bytes in hex).

Bit 9–Initialize Wire Image Buffer

When this bit is ON, the attachment will initialize its Wire Image Buffer (WIB). During this time no printing or forms movement takes place. There are two ways the WIB is initialized:

1. Byte Count = 0–The attachment initializes its WIB with the standard 64-character EBCDIC set. The system does not have to supply any data table in this mode.
2. The Byte Count is 8 or less–The attachment initializes its WIB with the standard 64-character set and then overlays characters in the table with alternate characters specified by the eight bytes of data transferred. The data transferred is bit significant, where each bit represents an alternate character. If the first bit is on, the first alternate character (see Appendix A and C) will overlay the appropriate character (EBCDIC equivalent) in the standard character set. If the second bit is on, the second alternate character is placed in the buffer and so on up thru the 64th bit.

If more than one alternate character is specified with the same EBCDIC representation, the last one specified is the one placed in the WIB.

Note. The Input/Output bit must equal 0 when Bit 9 is on. If the I/F bit equals 1, an exception interrupt with a DCB Specification check is reported.

Bit 10–Wire Image Transfer

When this bit is ON, the data transferred between processor storage and the attachment is to the Wire Image Table. No printing takes place while this bit is on. The byte count must be 1792 or less, depending on the character set. See Appendix C for more information.

Bit 11–Diagnostic

When this bit is ON, the data transferred between processor storage and the attachment will be diagnostic information. The attachment will transfer data between processor storage and the diagnostic address of the attachment specified in DCB word 4. If the I/F bit = 0 and the last byte transferred is on a word boundary, the attachment will branch to the last diagnostic address accessed when the byte count goes to 0.

Bits 12–14–Not used

Bit 15–Retry

When this bit is ON, the attachment will attempt to complete execution of the last Start I/O command issued. If this bit is on, the remainder of the DCB must be the same as the DCB being executed at the time of the exception interrupt (the printer attachment knows what step of the execution was in process when the exception occurred, DCB transfer, data transfer, carriage movement or printing).

The printer executes the necessary steps for completing the Start I/O command. The entire DCB is transferred to the printer. The data is transferred only if required. If the previous Start I/O command was successfully completed, the Retry Bit is ignored and the DCB is executed. After a Power On Reset, the command is executed as a normal DCB, and the other words in the DCB are checked and used if required. This command is terminated with a normal Device End interrupt, unless further exception conditions are detected and reported by an exception interrupt.

Forms Parameters–DCB Word 1

This word is not used if bit 8 of DCB Word 0 = 0. If this bit = 1, word 1 is used for forms parameters. Byte 0 is the new form length. If it is less than the current line position, the current line position is set to line one.

Byte 1 is the line where the printer is to stop form movement and/or printing and post an exception interrupt with Bit 0 on in the ISB. Cycle Steal Status word 1 will have the overflow bit (11) set on. This enables the printer to skip over restricted printing areas 0.5 inch from the folds. A Start Cycle Steal Status I/O command is issued to determine how many lines are required to complete the previous carriage operation (the residual line count) and/or the current line position status. Overflow interrupt is inhibited if Byte 1 = 0 or greater than the form length (Byte 0).

Forms Control–DCB Word 2

The Forms Control Word specifies whether a skip or space is to take place. For a skip, the attachment calculates how far the forms must be moved to get to the specified line. To space, the user tells the 4974 how many lines to move. The speed of the forms movement is the same, regardless of the modifier used.

Byte 0 of the forms control word is the skip. If this byte has a value between 0 and the maximum form length, the forms will move to that specified line. The printer will skip to the specified line on the next form if the line the form is presently on is equal to or less than the skip modifier. If the skip modifier is greater than the form length, an interrupt is posted and the DCB specification check is set in the ISB.

If Byte 0 = 0, Byte 1 is inspected for a space. If Byte 1 = 0, no forms movement will take place. If the space modifier is greater than zero the forms will move the number of lines specified. (If Byte 0 is greater than zero, Byte 1 is not checked.)

The maximum number of lines the forms should be moved with either a skip or space command is 84. When more than 84 lines (14 inches) of paper are moved in one operation, stacking and feeding problems occur.

DCB Word 3–Not Used

Diagnostic Address–DCB Word 4

When the diagnostic bit (11) is set in the DCB Control word, this word contains the address in the attachment where the diagnostic data transfer is to take place.

Chaining Address–DCB Word 5

This is the location of the next DCB table to be executed. If the chain address is odd, an interrupt is posted and a DCB specification check is set in the ISB. The chaining address is not checked unless the chaining flag is on in a valid control word.

Byte Count–DCB Word 6

If the byte count = 0, no data is transferred. If the byte count is greater than the maximum allowed for a particular operation, an interrupt is posted and a DCB specification check (bit 3) is set in the ISB.

For a Start I/O command with a modifier of "0000" the byte counts are:

Control Word Bits	*Maximum Byte Count*	*Function*
Bit 9 = 1	8	Initialize Wire Image Buffer
Bit 10 = 1	1792	Wire Image Transfer
Bit 11 = 1	*2048	Diagnostic Mode
Bits 9, 10, 11 = 0	132	Line Printing

*If the diagnostic transfer address is zero, the maximum byte count is 2048. If the address is greater than zero, the maximum byte count will be equal to 2048 minus the diagnostic transfer address. The attachment stops cycle stealing when the byte count goes to zero.

Data Address–DCB Word 7

This word contains the system storage address for the data associated with the operation to be performed.

Programming Considerations When Using the DCB

1. The entire DCB is fetched, but only the required words are checked. The contents of the words must be specified correctly.
2. The DCB address, chain address, and the status address must be even.

DCB Command Chaining

DCB command chaining is executed when the current DCB comes to a normal completion and a new DCB is fetched without issuing a new Operate I/O instruction. The DCBs belonging to such a sequence are said to be chained.

The first DCB in the chain contains the address of the next DCB. As each operation in the sequence is completed, the attachment uses the chain address stored in the current DCB to select the next DCB. The chained-to DCB is examined to determine which operation is next in the sequence and whether the associated device parameters are valid. DCB command chaining operations continue until a DCB is fetched having the chaining bit in the control word (DCB word 0) set to zero. This indicates the last operation in the chain.

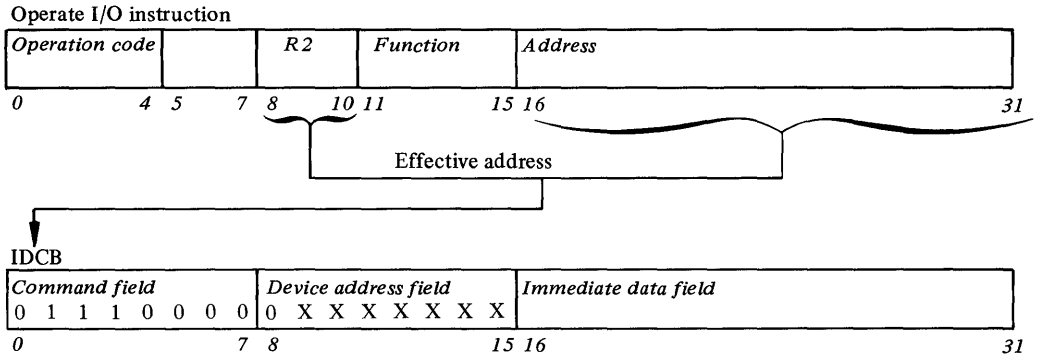
If an error occurs, chaining to succeeding DCBs is automatically suspended, and the attachment sends an interrupt request to the processor. The attachment does not request an interrupt until the last DCB operation in the chain is completed. By using command chaining, the processing time required to execute I/O operations is reduced.

As stated previously, the 4974 responds to the Start and Start Cycle Steal Status commands in cycle steal mode.

Start I/O Command

The Start command initiates all printer operations that transfer data to or from processor storage under direct program control and then in cycle steal mode. When the Operate I/O instruction is issued, the Start command is transferred under direct program control from the IDCB to the printer. While the printer is 'busy' executing the I/O operation, the processor continues with other operations. Beginning at the immediate field containing the DCB address specified in the IDCB, the eight words in the DCB are transferred to the printer from processor storage. The data is transferred in cycle steal mode one word at a time. The DCB information is decoded and the printer begins executing the operation called for in DCB control word (DCB word 0). Refer to "Control Word–DCB Word 0." When the operation (or operations when chaining) ends, an interrupt request is sent to the processor. At interrupt presentation time, a condition code and an interrupt ID word containing status information are presented to the processor.

Note. A Start I/O command issued to the printer while the device is Not-Ready, causes an interrupt with condition code 2 (Exception) and bit 0 (Device Dependent Status Available) set in the ISB. The Start command will not be executed. The format of the IDCB for the Start comand is:



Start Cycle Steal Status Command

The Start Cycle Steal Status command initiates the transfer of up to 6 bytes of status information from the printer attachment to processor storage. This status information is used to determine why a given command did not execute properly. The processor storage address is specified in word 7 of the applicable DCB. This command operates under direct program control and in cycle steal mode and causes the attachment to present an interrupt request when execution is complete.

The Start Cycle Steal Status command requires an Operate I/O instruction with the address of an IDCB, an IDCB with the address of the DCB, and a DCB. Figure 2-6 shows the formats of the IDCB, DCB and 6 bytes of status information.

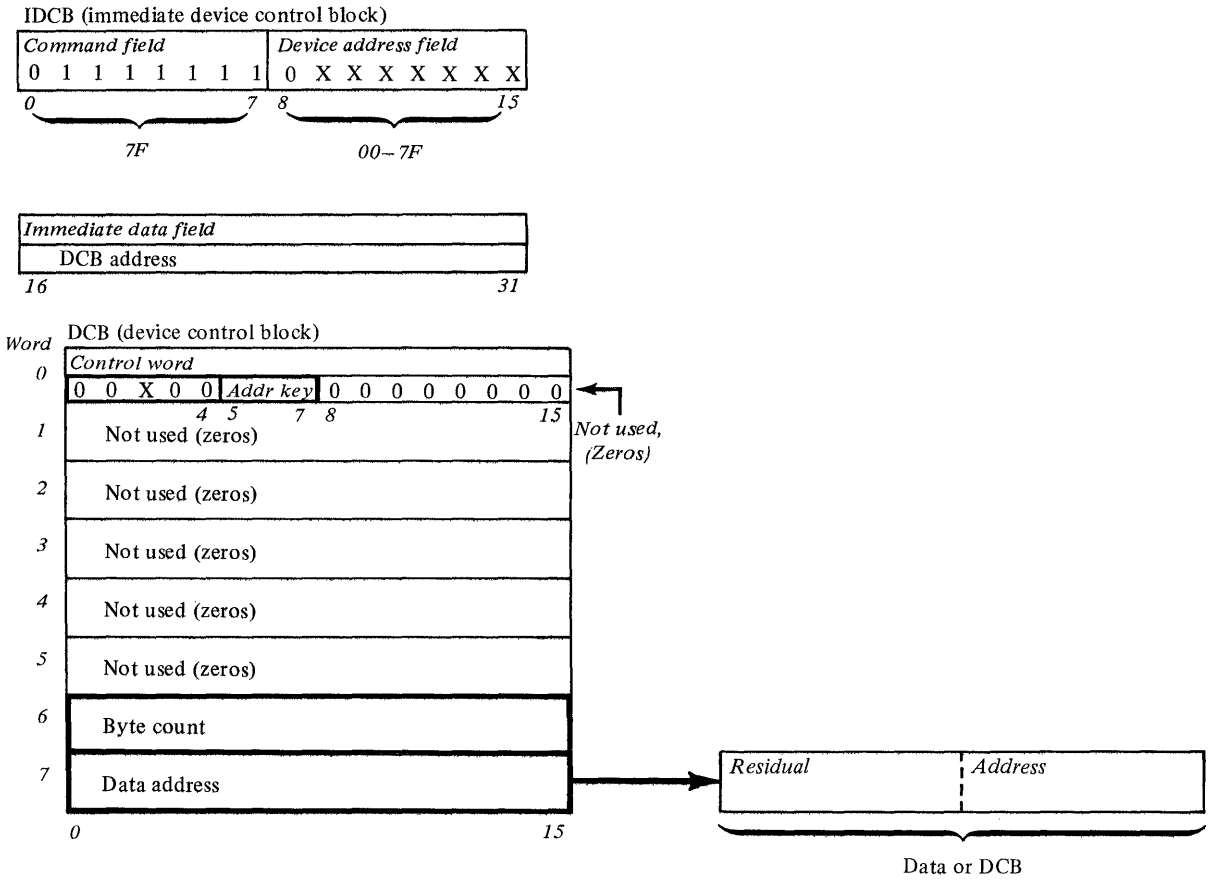


Figure 2-6. Start cycle steal status command and status information

Status Information

After execution of a given command under either DPC alone or under DPC and in cycle steal mode, status information will be reported to the processor for analysis of that command's execution. The three types of data that make up this status information are:

- Condition codes
- Interrupt ID word
- Cycle Steal Status

Condition Codes

A condition code is reported to the processor (1) at the completion of every Operate I/O instruction and (2) upon presentation of a priority interruption. The condition code is available in the even, carry and overflow bit positions of the Level Status Register (LSR) in the processor. Refer to "Prerequisite Publications" listed in the Preface of this manual for order numbers of the IBM Series/1 Processor Unit Description manuals that contain information on the LSR. For commands that do not cause interrupts, the condition code reported after the instruction is executed is the only status information required or available.

Condition codes reported at the completion of an Operate I/O instruction are:

Condition Code	*Meaning*
0	Device not attached
1	Busy
2	Busy after reset
3	Command reject
4	Not used
5	Interface data check
6	Not used
7	Satisfactory

Condition Code 0—Device Not Attached

Reported when the addressed device is not attached to the system.

Condition Code 1—Busy

Reported by the device when it is usable to execute a command because it is in the busy state. The device enters the busy state upon acceptance of a command that requires an interrupt for termination. It exits the busy state when the processor accepts the interrupt.

Condition Code 2—Busy After Reset

Reported by the printer when it is unable to execute a command because of a reset and the device has not had sufficient time to return to the quiescent state. No interrupt occurs to indicate termination of this condition.

Condition Code 3—Command Reject

Reported by the printer when:

1. A command is issued that is outside the device command set.
2. The device is in an improper state to execute the command.
3. The IDCB contains an incorrect parameter. For example: an odd byte DCB address, or an incorrect function/modifier combination.

When the printer reports command reject, it does not fetch the DCB.

Condition Code 5—Interface Data Check

Reported by the printer or the channel when a parity error is detected on the I/O data bus during a data transfer.

Condition Code 7—Satisfactory

Reported by the printer when it accepts the command. Condition codes reported during priority interruptions are:

Condition Code	*Meaning*
0	Not used
1	Not used
2	Exception
3	Device end
4	Attention
5	Not used
6	Not used
7	Not used

Condition Code 2—Exception

This code is reported when an error or exception condition is associated with the interrupt. This condition is described in the Interrupt Status Byte (ISB) and further described in the 16 bytes of status information.

Condition Code 3—Device End

This code is reported when no error exception or attention conditions occur during the I/O operation. A normal termination of the operation has occurred.

Condition Code 4—Attention

This code is reported when the printer goes Ready after being in the Not Ready state.

Along with the interrupt condition code, the attachment also transfers an interrupt ID word which provides additional information on interrupting conditions.

Interrupt Identification Word

Acceptance of an I/O interrupt causes the attachment to place an ID word in register 7 (R7) of the interrupted level. For condition code 2, the Interrupt ID word consists of the Interrupt Status Byte (ISB) and the address of the interrupting device. The first byte will be zero for all other condition codes. The format is as follows:

Interrupt ID word

IIB								*Device address*							
0	0	0	0	0	0	0	0	0	X	X	X	X	X	X	X
0							*7*	*8*							*15*

Interrupt Status Byte

The ISB stores accumulated status information.

The format of the ISB is:

0–Device Dependent Status Available
1–Delayed Command Reject
2–Not Used
3–DCB Specification Check
4–Storage Data Check
5–Invalid Storage Address
6–Protect Check
7–Interface Data Check

Bit 2 of the ISB is not supported and should always be returned as zero.

Bit 0–Device Dependent Status Available

Set ON when:
Additional status information (residual address and status bits), is available from the 4974. A Start Cycle Steal Status command must be issued to get this information.

Bit 1–Delayed Command Reject

Set ON when:
The printer cannot execute a command because of an incorrect parameter in the IDCB.

This bit is only set in the ISB when the attachment is incapable of recording the condition with condition codes during the I/O instruction. The operation in progress is terminated and an interrupt request is generated. Condition code 2 is reported at interrupt accept time. The Residual Address is not revelant to error recovery (see Cycle Steal Status Word 0).

Bit 3–DCB Specification Check

Set ON when:
The printer cannot execute the command because a parameter in the DCB is incorrectly specified to perform the desired operation.

Examples: An odd byte chaining address, an odd address for start cycle steal status, an invalid command in the control word or an incorrect count. Condition code 2 is reported at interrupt accept time. The Residual Address will be the last word of the DCB.

Bit 4–Storage Data Check

Set during cycle steal output operations only. It indicates that the storage location accessed during the current output cycle contained bad parity. The parity in processor storage is not corrected. The attachment issues the status in the ISB and terminates the operation. Condition code 2 is reported at interrupt accept time.

Bit 5–Invalid Storage Address

Set on as a result of a cycle steal I/O operation when the main storage address presented by the attachment for data or DCB access exceeds the storage size specified on the system. The attachment records the status and terminates the operation. Condition Code 2 is reported at interrupt accept time.

Bit 6–Protect Check

Set ON when:
The attachment attempts to access a storage location without the correct storage protect key. (Refer to the *IBM Series/1 Model 5 4955 Processor and Processor Features Description,* GA34-0021, or the *IBM Series/1 Model 3 4953 Processor and Processor Features Description,* GA34-0022). The operation is terminated and condition code 2 is reported at interrupt accept time.

Bit 7–Interface Data Check

Set ON when:
A parity error is detected on a cycle steal data transfer. The condition can be detected by the attachment or by the channel. In either case, the operation is terminated and an interrupt is reported to the processor.

Condition code 2 is presented at interrupt accept time (see Figure 2-7 for condition code and status information).

Cycle Steal Status Words

Six bytes of status information are transferred to the processor upon execution of the Start Cycle Steal command. This information has the following format and meaning:

Word		
0	Residual address	
1	Device status	
2	Byte 0 Residual line count	Byte 1 Current position
3	Byte 0 Form length	Byte 1 Overflow line
4	External interface status	
5	Printer interface status	
6	Current attachment marks	
7	Byte 0 Logical left margin	Byte 1 Logical right margin
	0	*15*

Residual Address–Word 0

This address will be the storage location of the last attempted cycle steal transfer. This address may be a DCB or data address. If the last transfer attempted was a word transfer, the Residual Address will be pointing to the odd byte of the word. A cycle steal status will not alter the residual address. A Device Reset, System Reset or a Halt I/O command may cause the residual address to be indeterminate. Only the Power On Reset will reset the residual address to zero.

Operate I/O Instruction Execution Time

CC Value	*Meaning*
0	Device not attached
1	Busy
2	Busy after reset
3	Command reject
4	Not reported
5	Interface data check
6	Not reported
7	Satisfactory

Interrupt Presentation Time

CC Value	*Meaning*	
0	Not reported	
1	Not reported	
2	Exception	Indicates more information in interrupt status byte (ISB)
3	Device end (satisfactory)	
4	Attention	
5	Not reported	
6	Not reported	
7	Not reported	

Interrupt Status Byte

Bit Position	*Meaning*	
0	Device status available	Indicates more information in cycle steal status word 1
1	Delayed command reject	
2	Not reported	
3	DCB specification check	
4	Storage data check	
5	Invalid storage address	
6	Protect check	
7	Interface data check	

Issue a start cycle steal status command

Cycle Steal Status Word 1

Bit Position	*Meaning*
00	Printer not ready
01	Printer wire check
02	Printer power check
03	Wait
04	Forms emitter check
05	Margin check
06	Print emitter check
07	Forms stalled
08	Attachment wire check
09	External interface
10	Printer interface check
11	Overflow
12	End of forms
13	Invalid wire image
14	No print emitter
15	Not used (zero)

Figure 2-7. Status information summary

Device Status– Word 1

When Bit 0 of the ISB is set ON, Device Status word 1 will further explain the condition that caused the exception interrupt (CC2). This status will not be reset until the next Start I/O command. The information in the Device Status word does not necessarily reflect current status, but reflects the status at the time of the last non-cycle steal status interrupt.

Bit 0–Printer Not Ready(Disconnect or Power OFF)

The attachment receives no response from the printer when a data wrap sequence is executed. This means the power to the printer is off or the printer signal cable is disconnected. Checking bit 9 (external interface check bit) of Status Word 1 will show which error is occurring.

Bit 0	Bit 9
1	0 = Printer Power OFF
1	1 = Cable Disconnected

The remaining status bits in the device status word may not be valid if bit 0 or bit 9 is on.

Bit 1–Printer Wire Check

When a print coil driver is on from 1.6 to 3.0ms, a printer wire check is set, a 24V regulator is turned off and a printer power check occurs. When the coil driver condition is corrected, the power check is reset.

Bit 2–Printer Power Check

A printer power check is set if the:

- Printer 24V is not within tolerance
- Printer 5V is not present
- Printer 10.8V is not within tolerance
- Wire check occurred

This bit is reset when the condition causing the wire check is corrected.

Bit 3–Wait

The Wait bit is set if the Mode switch is not in the PRINT position on the printer, and the attachment cannot execute any action command. To determine the completion status of the current command, check the residual line count to see if the forms operation was completed. If it is not zero or the residual address points to the first print character, no printing has taken place. An exception interrupt will be posted.

Bit 4–Forms Emitter Check

The position of the forms is monitored any time the printer is ready and not in the wait state. As the position is altered, either manually or under program control, the current line position is updated. If the two forms emitters change simultaneously, the current line position cannot be updated properly. If this simultaneous change is detected the forms emitted check is set.

Bit 5–Margin Check

This bit is set whenever the left margin is not detected at the expected time. When a margin check occurs it is possible that the previously printed line was not printed properly. This check may occur after a normal device end interrupt is posted.

Bit 6–Print Emitter Check

This bit is set if the print emitters come too fast or if print emitters are detected out of proper sequence.

Bit 7–Forms Stalled

If the forms should be moving under program control but no movement is detected in the forms emitter in a 250 millisecond period, this bit is set.

Bit 8–Attachment Wire Check

This bit is turned on when the attachment detects an active signal when it should be inactive or when it detects an inactive signal when it should be active.

Bit 9–External Interface Check

Periodically the attachment does a diagnostic checkout of the external cable interface. This check bit is set if: The cable is disconnected, or a grounded or an open signal line exists, or there is a bad line driver. This condition does not cause an exception interrupt.

Bit 10–Printer Interface Check

When the printer turns on or off a stepper motor driver line or reset line, it checks to see if the appropriate lines switched on the printer interface. If a line does not switch properly, bit 10 is set.

Bit 11–Overflow

This bit is set if the forms have stopped on the overflow line. If the forms were to move beyond the overflow line there is a residual line count in Device Status word 2. No printing occurs for the current DCB. The residual address can be anywhere in the print line.

Bit 12–End of Forms (EOF)

At the completion of a forms movement operation the forms switch is checked. If the switch is open (indicating no forms), the End of Forms bit is set and an exception interrupt is posted. No printing is attempted when this condition is detected. The EOF condition occurs when there is 1 to 3 inches of paper remaining in the printer.

Note. If a multi-line forms movement command has been given in the command for which this exception interrupt is given, the amount of paper remaining in the printer may be reduced by the number of lines the command spaced. Print commands must be issued with no spacing in order to print on any of the remaining paper. After all printing is completed, spacing of forms should be executed to provide the operator with a visual indication of the EOF status.

Bit 13–Invalid Wire Image

As characters to be printed are transferred to the print line buffer, they are analyzed to determine if they are valid EBCDIC printable characters. If during this process an invalid sequence of check bytes is detected, the bit is set ON. When printing, if the Wire Image Buffer calls for the same wire to be fired in two adjacent emitter times, the invalid wire image bit is set on and a exception interrupt with a Device Status is posted.

Bit 14–No Print Emitter

This bit is set on if no print emitters are detected when head movement is initiated.

Bit 15–Not used, should be zero.

Residual Line Count/Current Position–Word 2

The Residual Line Count (byte 0 of Status word 2) contains the number of lines the forms would have to move to complete the forms control of the last operation. This count is not valid if an error occurred during the transfer of the last DCB. Normally this count is zero.

On an overflow interrupt, if the carriage is to move beyond the overflow line, the *remaining* lines required to be moved to complete the operation are in the Residual Line Count. If an error such as Forms Stalled occurs during forms movement, the *number* of lines that remain to be moved to complete the forms operation are in the Residual Line Count.

Current forms position (byte 1 of Status word 2) always contains the current line position of the forms. This position will be changed by programmed or manual movement of the forms.

Forms Length/Overflow Line–Word 3

The form length (byte 0 of Status word 3) and the overflow line (byte 1 of Status word 3) are the most recent forms parameters successfully transferred to the printer from the system. If no forms parameters have been transferred, the default values of form length equal to 66 and overflow line equal to 60 will be presented.

External Interface Status–Word 4

See *Note.*

Printer Interface Status–Word 5

See *Note.*

Current Attachment Marks–Word 6

See *Note.*

Logical Left Margin/Logical Right Margin–Word 7

The logical left margin (High Order Byte) and logical right margin (Low Order Byte) represent the boundaries of the characters remaining to be printed when an exception interrupt has terminated a print operation. The logical margin values are equal to the physical print position plus 16. When the print line is transferred from storage, the attachment suppresses unprintable characters and blanks and adjusts the logical margins to reflect the bounds of the printable characters. As printing takes place, the margin from which the printhead is moving will be modified by one, each time a print position is completed.

Note. Status Word 4, 5, and 6 are used for diagnostic purposes and are not explained in this manual.

Status After Power On and Resets

During Power On Reset the following actions occur:

- The printer performs Internal Register, Data Flow and Storage Tests. The printer will remain Busy if these tests fail. If they are successful the printer initializes the Wire Image Buffer which the standard character set and clears all internal buffer locations.
- The forms length is initialized to 66 lines.
- The overflow line is initialized to line 60. The forms are assumed to be positioned on line one.
- The residual address is set to zero.
- The printhead is moved to the left margin if the printer is ready and if the printhead is not already at the left margin.

During System or Device Resets:

- Printing and carriage movement stop.

The printer may stop part way through printing a character or spacing a line. If the forms stop between lines, registration will be restored with the next form movement command.

- All pending interrupts are reset. If the printer was in the process of updating the storage access registers (Residual Address) when the reset occurs, the Residual Address may be indeterminate.

During a "Note Ready" condition:

- Printing stops when the current character is completed.
- Forms movement is stopped on the current line.
- An interrupt is sent to the system with a printer power check bit set on in Device Status Word 1.

Appendix A. EBCDIC Character–Hexadecimal Equivalent

Character	*EBCDIC (Hex)*	*Character*	*EBCDIC (Hex)*
A	C1	6	F6
B	C2	7	F7
C	C3	8	F8
D	C4	9	F9
E	C5	Space	40
F	C6	¢ Cent Sign	4A
G	C7	. Period	4B
H	C8	< Less than	4C
I	C9	(Left Parenthesis	4D
J	D1	+ Plus	4E
K	D2	| Logical OR	4F
L	D3	& Ampersand	50
M	D4	! Exclamation Point	5A
N	D5	$ Dollar Sign	5B
O	D6	* Asterisk	5C
P	D7	) Right Parenthesis	5D
Q	D8	; Semicolon	5E
R	D9	¬ Logical NOT	5F
S	E2	– Minus-Hypen	60
T	E3	/ Slash	61
U	E4	\ Reverse Slant	E0
V	E5	, Comma	6B
W	E6	% Percent	6C
X	E7	_ Underscore	6D
Y	E8	> Greater than	6E
Z	E9	? Question mark	6F
0	F0	: Colon	7A
1	F1	# Number	7B
2	F2	@ At	7C
3	F3	' Prime Apostrophe	7D
4	F4	= Equal	7E
5	F5	" Quotation mark	7F

Appendix B. Printer Forms

The Forms Tractor Unit is recommended for single-part, continuous margin punched forms and is required for continuous multipart and continuous preprinted margin punched forms.

All forms must meet the following requirements:

Minimum thickness	.003 inches
Maximum width	14.5 inches
Minimum length	3.0 inches

Cut Forms

Single part cut forms must meet the following requirements:

Maximum thickness	.0075 inches
Minimum width	6.0 inches
Maximum length	14.0 inches

Multipart cut forms must meet the following requirements:

Maximum thickness	.018 inches
Minimum width	6.0 inches
Maximum length	14.0 inches
Maximum copies	original plus five

Continuous Forms

Maximum thickness	.018 inches
Minimum width	3.0 inches
Maximum distance between folds	14.0 inches
Maximum copies	original plus three
Maximum forms weight	15 lbs. per ream (6,804 kg)

Remember, when using forms:

Do not use continuous form card stock.
Do not use stapled forms.
Do not use partially separated forms.
Multipart forms should be glued at the top and not crimped.
Printing should be restricted to 0.5 inches from all edges or folds.

The printer will accept up to six part forms, however, five and six part forms should be tried for satisfactory feeding, registration, and print quality.

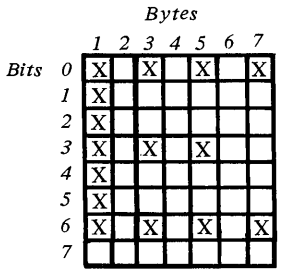
Appendix C. Wire Image Table

General Description

The purpose of the Wire Image Table (WIT) is to convert an 8-bit code into a wire image pattern. Since the WIT is loaded from the using system, special characters may be easily added to the table, or new tables may be generated.

Wire Image Character Pattern Generation

The printer uses an 8 x 7 dot matrix pattern to print its characters. Seven bytes of data are used to represent the wire image pattern for each character. Each byte corresonds to one column of the matrix, starting with byte 1 as the leftmost column and bit 0 as the uppermost bit. For example, an "E" is shown as:



Column 1 has bits 0 through 6 on, making its hexadecimal value FE. Column 2 has no bits on, therefore, its value is 00. Column 3 is represented by a 92, 4 by a 00, 5 by a 92, 6 by a 00, and 7 by an 82. The location representing an "E" within the WIT would contain Hex FE 0092 0092 0082 as the wire image pattern.

Two rules must be considered when creating characters:

1. Adjacent dots within a row may not be used. (Adjacent dots within a column are permissible). Attempting to use adjacent dots will result in an Invalid Wire Image check.
2. No more than 25 dots may be used within any one character.

Wire Image Table Structure

The WIT must consist of not less than 512 bytes (64 characters) and not more than 768 bytes (96 characters). If less than 64 characters are desired, NULL characters must be used to complete the 64-character set. A NULL character is defined as one having a wire image pattern of zero.

Each character to be printed requires eight bytes of data, using the following format:

Bits 0, 1	check bits
Bits 2–7	displacement field
Bits 8–63	wire image pattern

When a character is to be printed, the user supplies the 8-bit character code. The 4974 uses these eight bits to access the correct wire image pattern within the WIT.

The entry point into the WIT is determined by the following formula:

Entry Point = 8 x (Value of bits 2 through 7 of the specified character code).

The check bits at this address are compared to bits 0 and 1 of the specified character code. If they agree, the correct point in the table has been reached, and the character will be printed using the wire image pattern in bits 8 through 63. If the check bits do not agree, a new address will be generated using the displacement field located at the entry point.

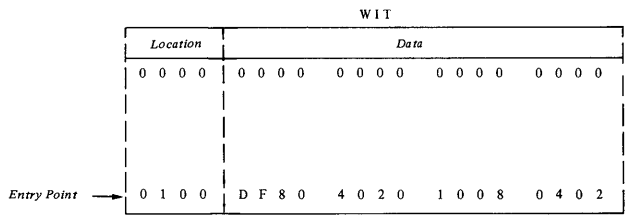
Next Address = Entry Point Address + 8 x (Displacement Field + 3)

The check bits at the new address will be compared to bits 0 and 1 of the requested character. If they still do not agree, the indexing procedure will be repeated using the new displacement field.

Next Address = Previous Address + 8 x (Displacement Field + 3)

A total of four accesses into the table are allowed. Exceeding this limit will cause an Invalid Wire Image check. A zero in the displacement field indicates no indexing is to occur. The minimum index possible is four-character positions.

As an example, consider the standard EBCDIC Wire Image Table (Figure C-3). Suppose the character to be printed is a dash. The EBCDIC code for a dash is a hex 60, or 0110 0000. Therefore, the check bits would be 01, and the table would be accessed at a hex (20 x 8), or hex 0100.



Bits 0 and 1 at location 0100 are 11, which does not agree with the 01 of the character to be printed. This indicates that you must index to a new location using bits 2 through 7 as your displacement.

Next Address = 0100 + [8 x (1F + 3)] = 0210.

WIT

Location	*Data*			
0 0 0 0	3 D 0 0	0 0 0 0	0 0 0 0	0 0 0 0
0 1 0 0	D F 8 0	4 0 2 0	1 0 0 8	0 4 0 2
0 2 1 0	4 0 1 0	0 0 1 0	0 0 1 0	0 0 1 0

Bits 0 and 1 at location 0210 are 01, indicating that this is the desired character. The wire image patter 10 0010 0010 0010, corresponding to a dash, is printed.

Wire Image Table Generation

The following steps should be followed in the generation of a W.I.T.

1. Define the character set.
   Each character must be assigned an 8-bit character code and a 7-byte wire image pattern. Only printable characters should be included in the character set. A "space" should not be included.
2. Place the character set into a properly ordered table. Figure C-1 is a flowchart of a procedure for ordering the character set into a usable format.
3. Calculate the Check Bits and Displacement Field for each character in the table. The check bits for each character are simply bits 0 and 1 of the character code. Figure C-2 is a flow chart of a procedure for calculating the displacement fields for the character set ordered in step 2.

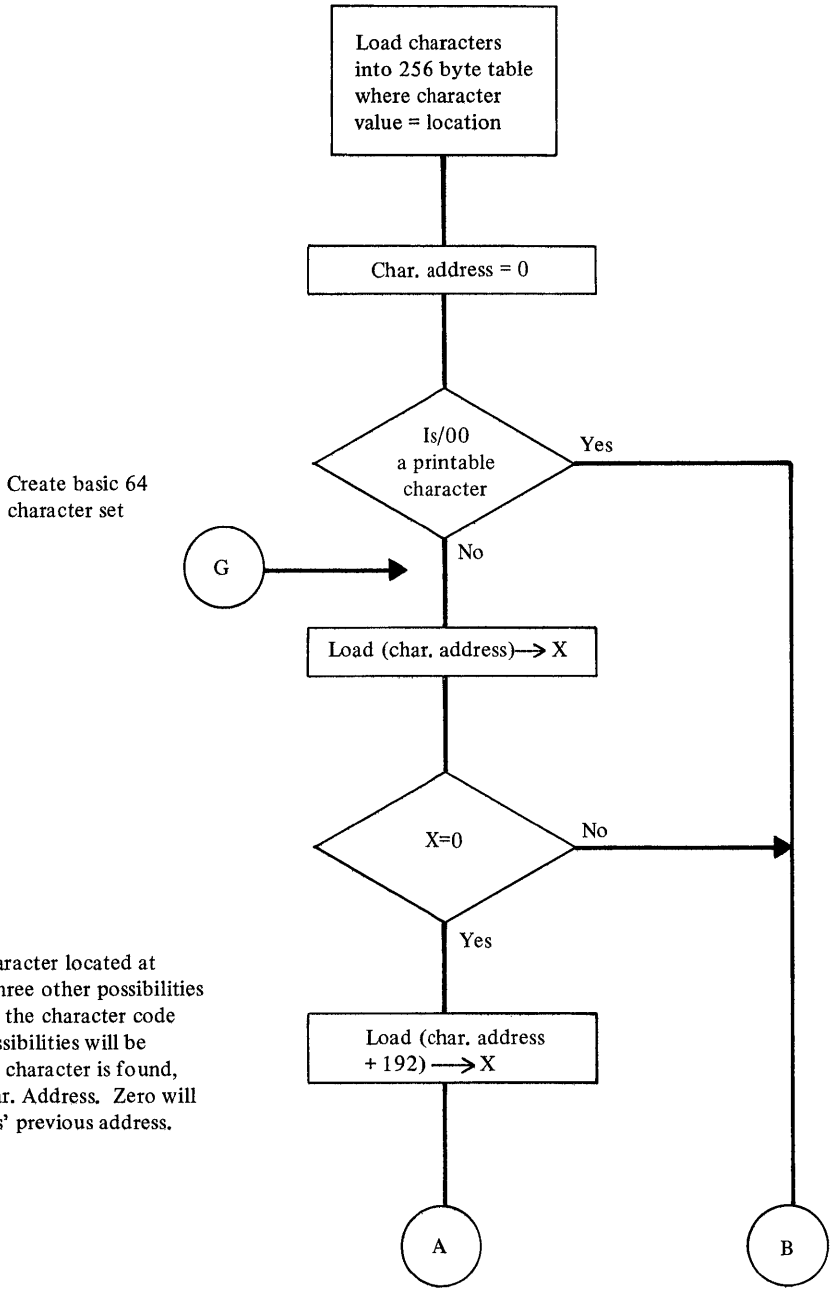
Note. If a Table Overflow Error occurs while following the procedure in Figure C-2, the table should be reordered to eliminate any indexes of less than four table positions.

Example. Position 95 indexes to position 96.

The table should be reordered as shown below, and the displacement fields recalculated.

Old Order		*New Order*	
Table Entry	#91	Table Entry	#91
	92		95
	93		92
	94		93
	95		94
	96		96

Place character set into ordered table.



If there is no printable character located at Char. Address, there are three other possibilities having bits 2 through 7 of the character code the same. These three possibilities will be checked and if a printable character is found, it will be stored at the Char. Address. Zero will be stored at the characters' previous address.

Figure C-1 (Part 1 of 7). Flowchart procedure for formatting a character set

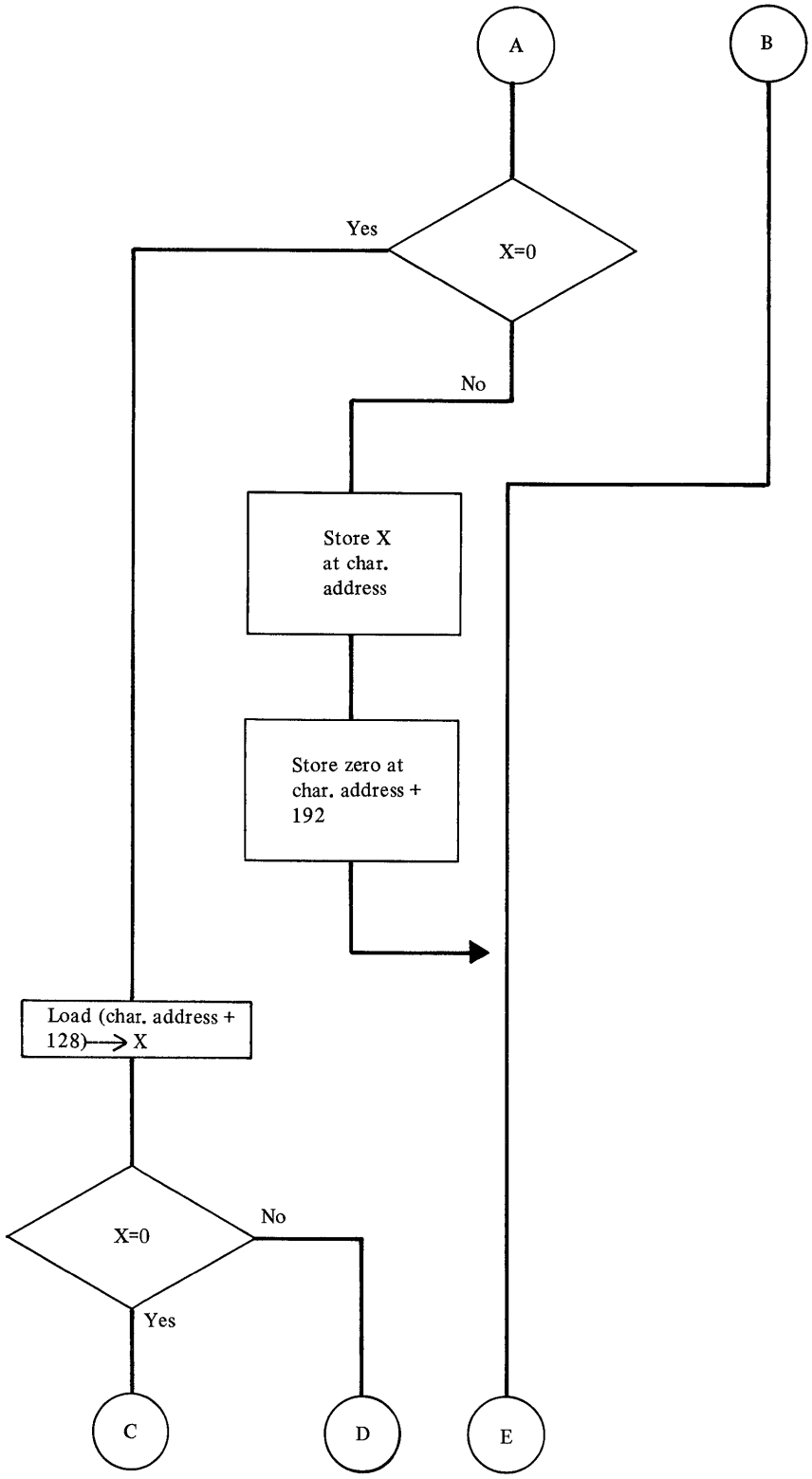


Figure C-1 (Part 2 of 7). Flowchart procedure for formatting a character set

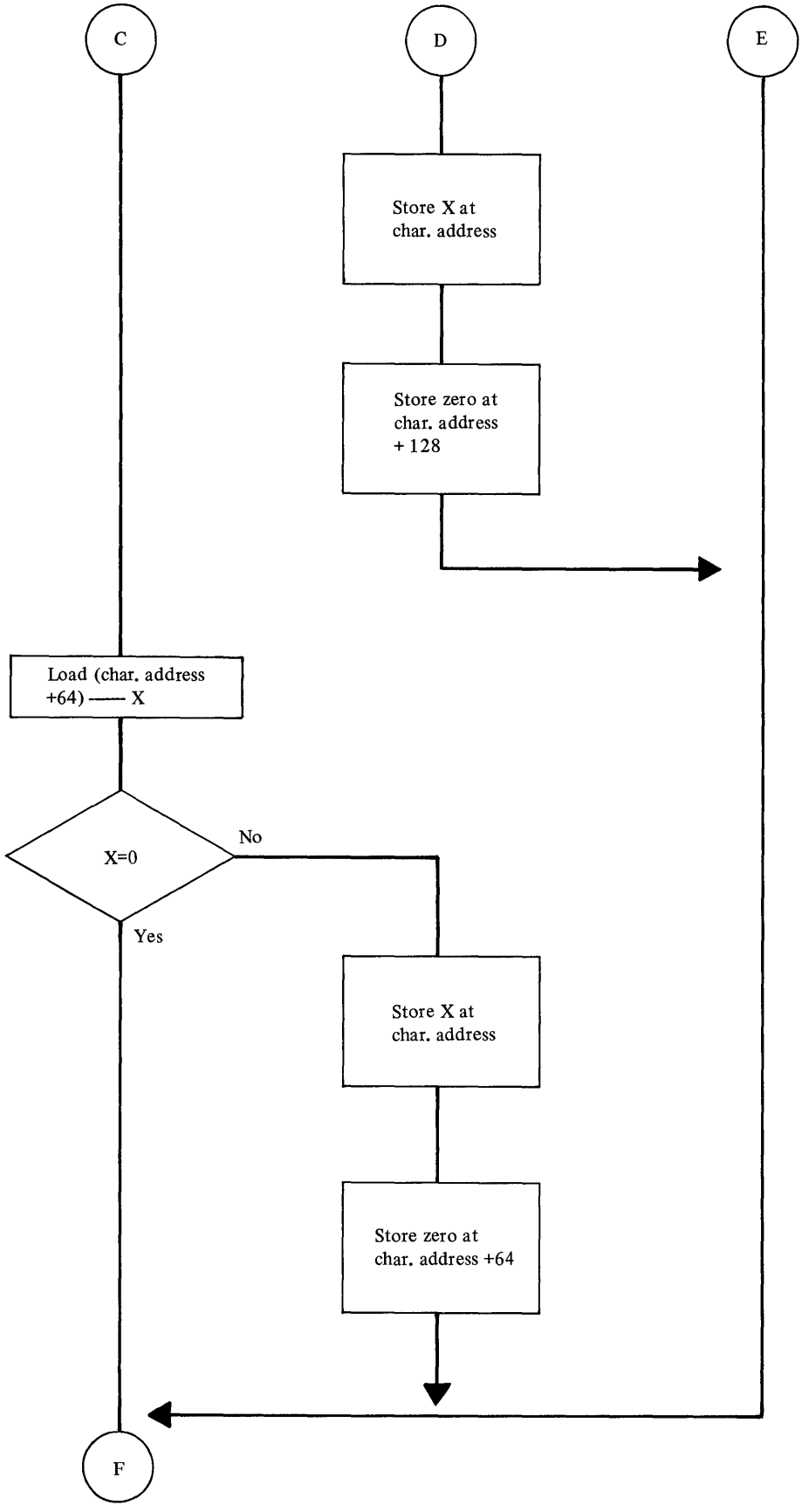


Figure C-1 (Part 3 of 7). Flowchart procedure for formatting a character set

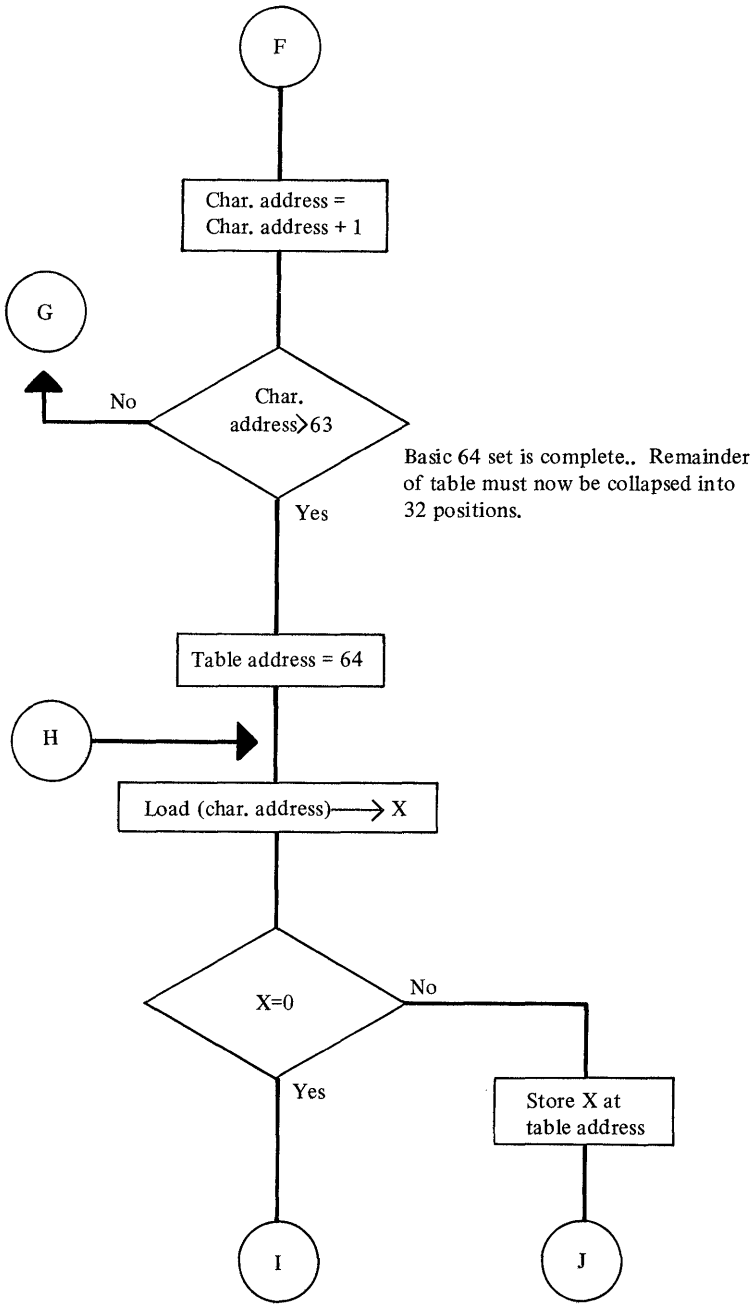


Figure C-1 (Part 4 of 7). Flowchart procedure for formatting a character set

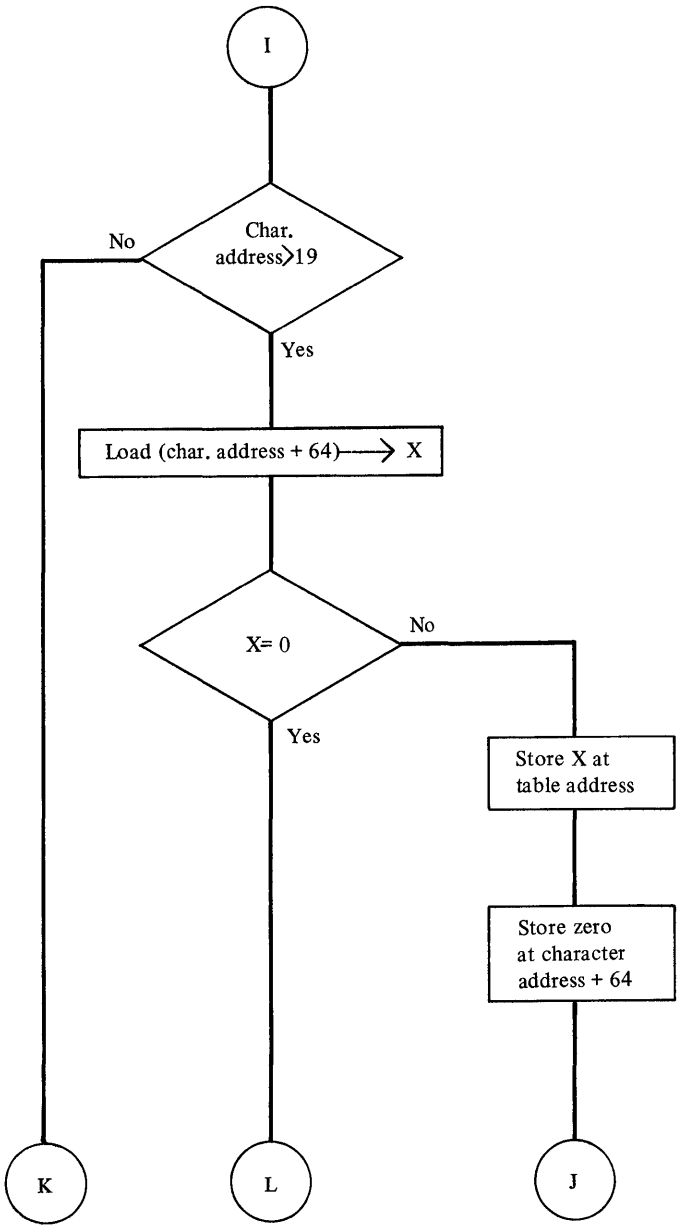


Figure C-1 (Part 5 of 7). Flowchart procedure for formatting a character set

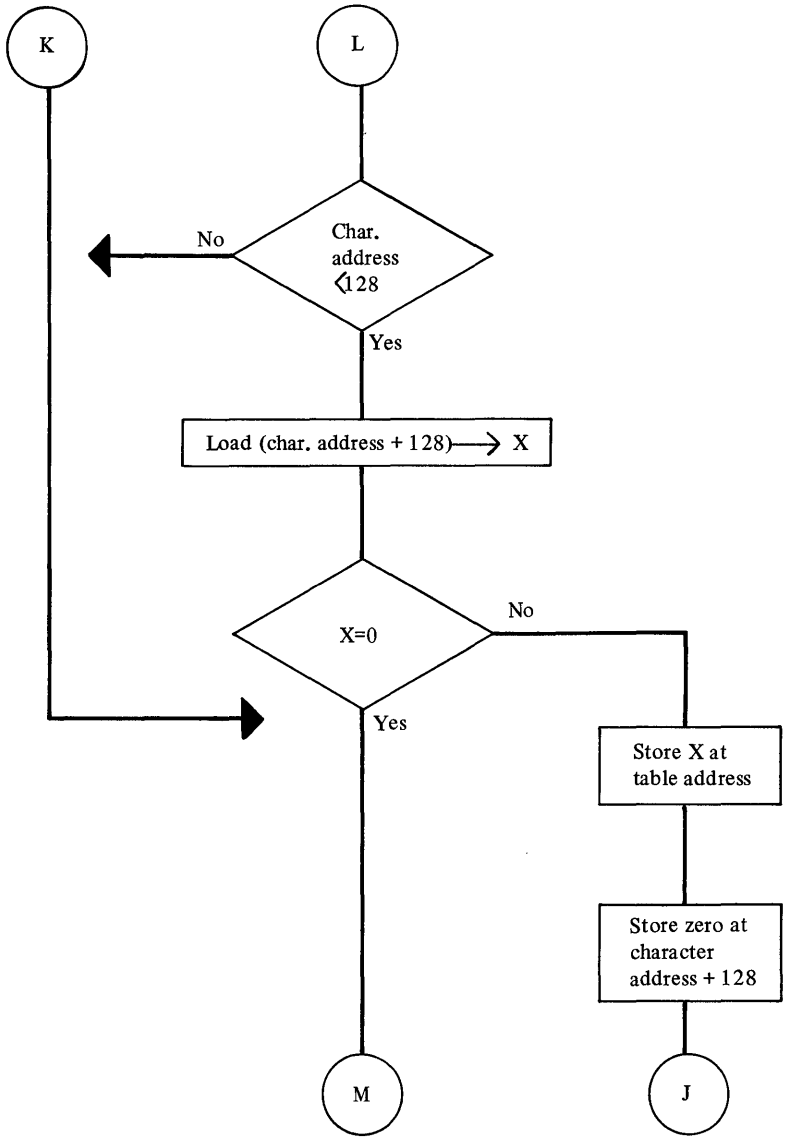


Figure C-1 (Part 6 of 7). Flowchart procedure for formatting a character set

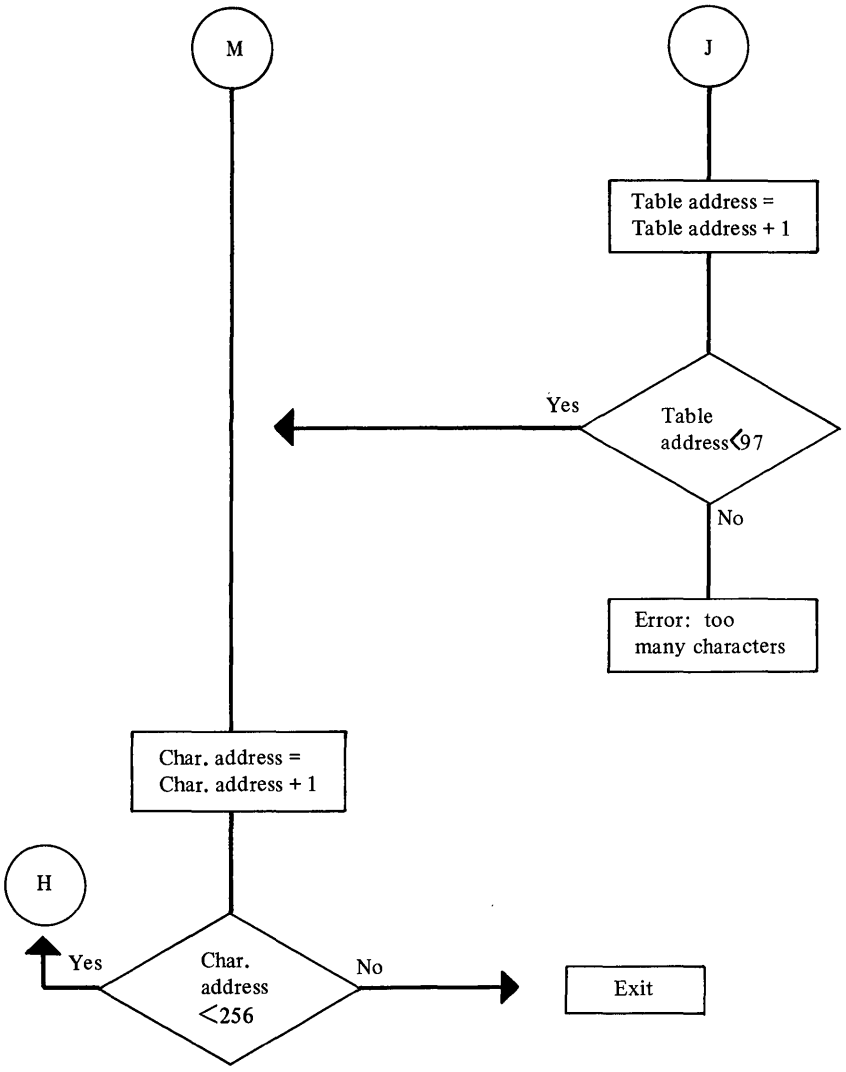


Figure C-1 (Part 7 of 7). Flowchart procedure for formatting a character set

Calculate displacement fields for characters in W.I.T.

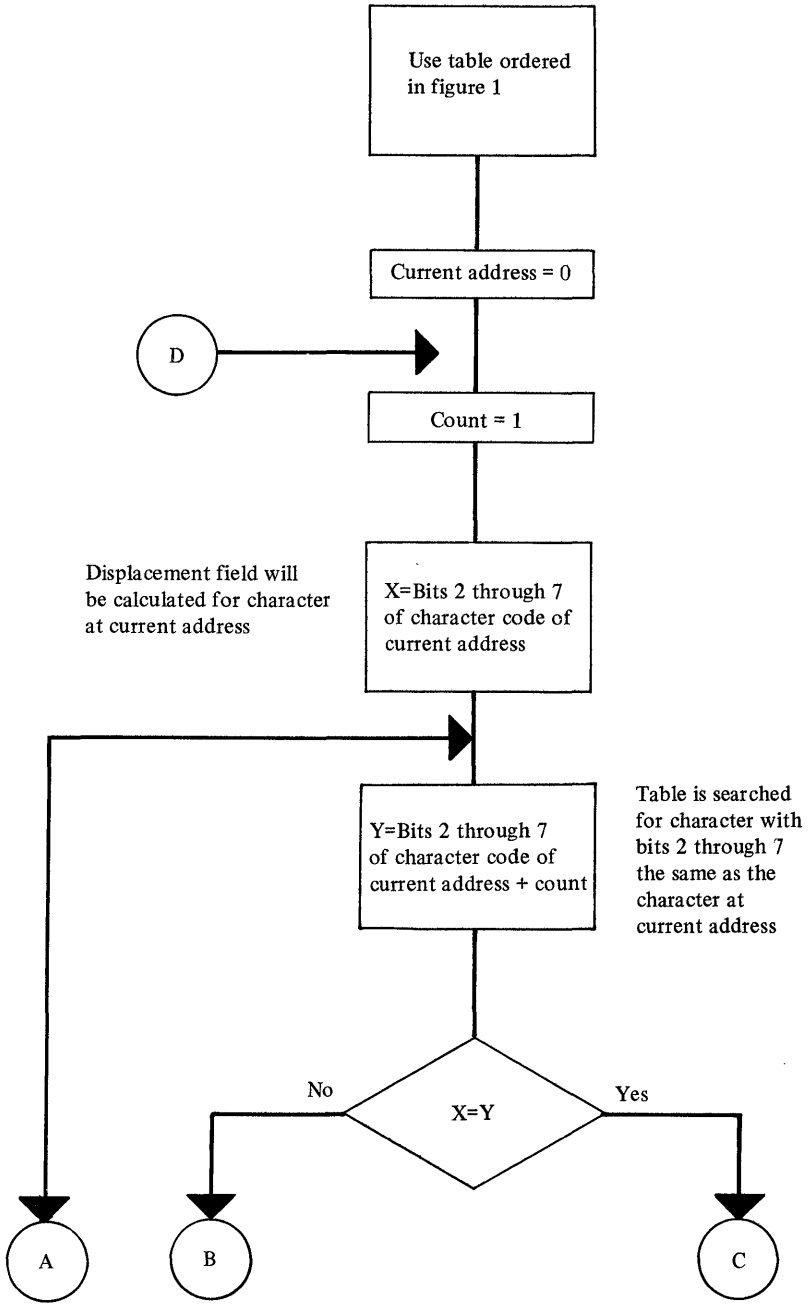


Figure C-2 (Part 1 of 3). Flowchart for calculating displacement fields for characters in the Wire Image Table

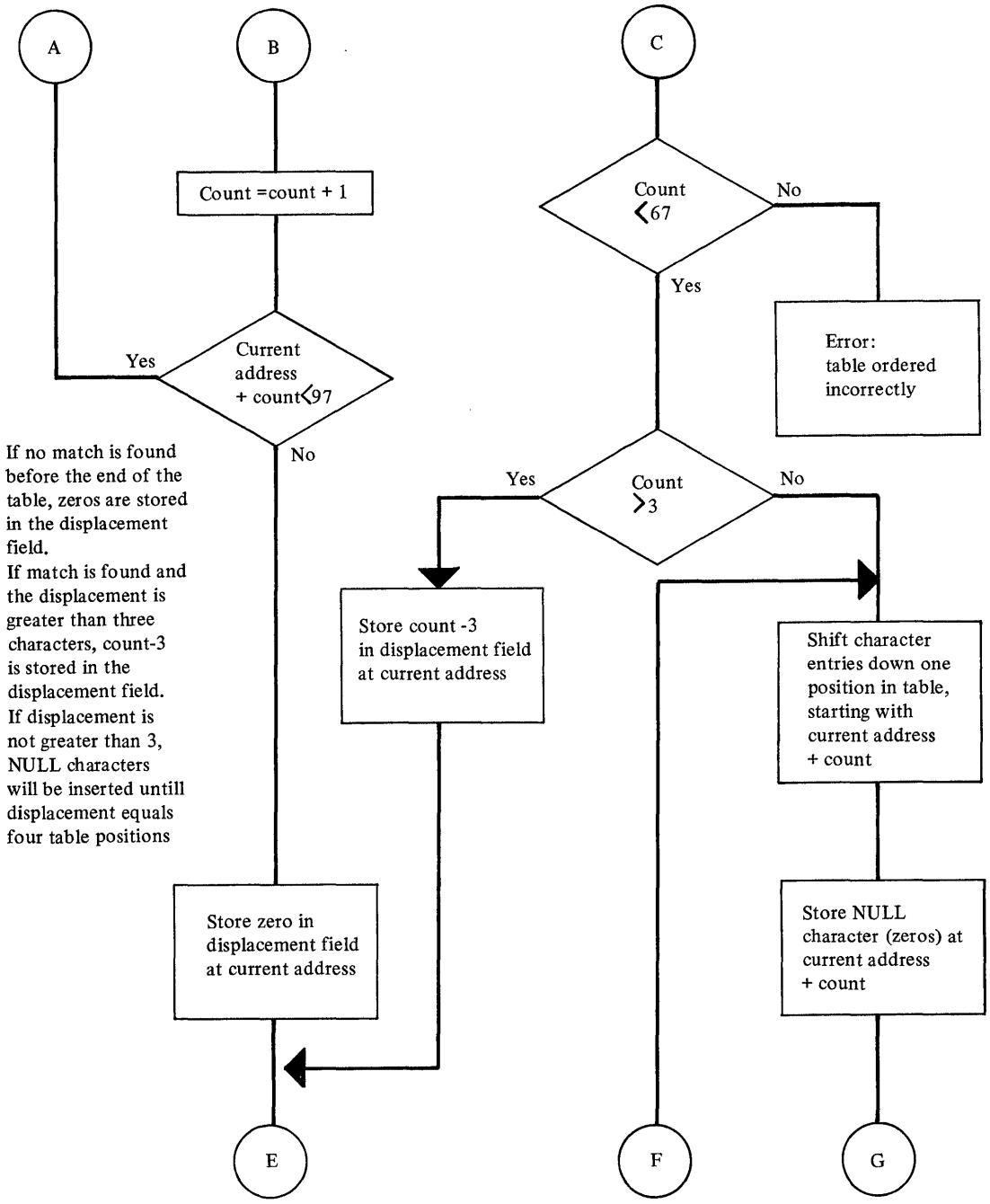


Figure C-2 (Part 2 of 3). Flowchart for calculating displacement fields for characters in the Wire Image Table

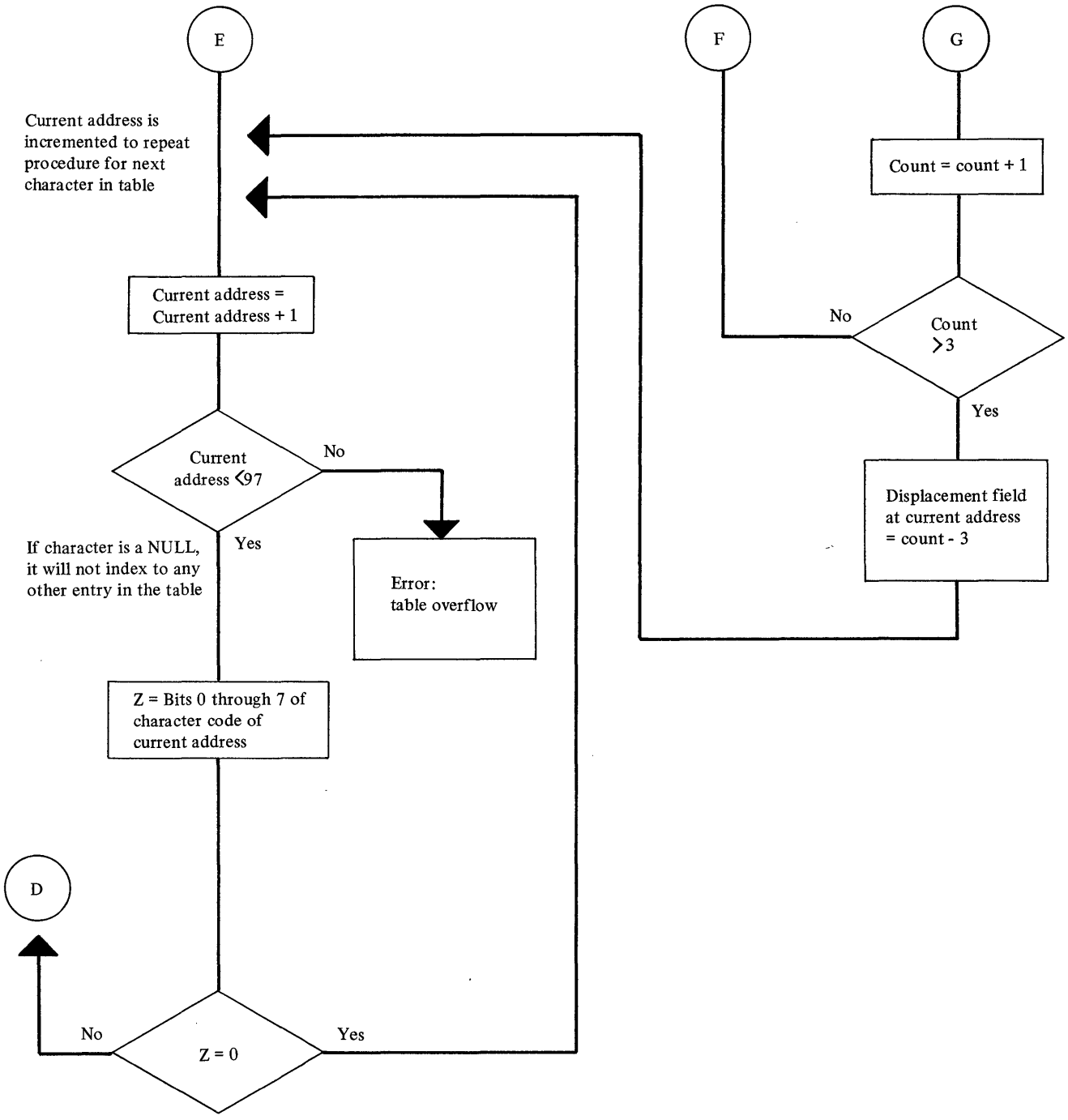


Figure C-2 (Part 3 of 3). Flowchart for calculating displacement fields for characters in the Wire Image Table

ADDRESS	*HEX CODE*	*PRINTED CHARACTER*	*WIT VALUE*			
0000	00	null character	3D00	0000	0000	0000
0008	C1	A	C01E	2048	8048	201E
0010	C2	B	C082	7C82	1082	106C
0018	C3	C	C07C	8200	8200	8244
0020	C4	D	C082	7C82	0082	007C
0028	C5	E	C0FE	0092	0092	0082
0030	C6	F	C0FE	0090	0090	0080
0038	C7	G	C07C	8200	8210	825C
0040	C8	H	C0FE	0010	0010	00FE
0048	C9	I	C000	8200	FE00	8200
0050	4A	cent	4038	4400	C600	4400
0058	4B	period	4000	0006	0006	0000
0060	4C	less than	4000	1028	4482	0000
0068	4D	left parenthesis	4000	0038	4482	0000
0070	4E	plus	4010	0010	6C10	0010
0078	4F	logical or	4000	0000	FE00	0000
0080	D0	closing brace	EE00	8200	826C	1000
0088	D1	J	C004	0200	0200	02FC
0090	D2	K	C0FE	0020	1048	0482
0098	D3	L	C0FE	0002	0002	0002
00A0	D4	M	C0BE	4020	1020	40BE
00A8	D5	N	C0BE	4020	1008	04FA
00B0	D6	O	C07C	8200	8200	827C
00B8	D7	P	C0FE	0090	0090	0060
00C0	D8	Q	C07C	8200	8208	847A
00C8	D9	R	C0FE	0090	0098	0462
00D0	5A	exclamation point	4000	0000	F600	0000
00D8	5B	dollar	4020	5400	D600	5408
00E0	5C	asterisk	4010	4438	0038	4410
99E8	5D	right parenthesis	4000	0082	4438	0000
00F0	5E	semicolon	4000	00DA	04D8	0000
00F8	5F	logical not	4010	0010	0010	001C
0100	E0	reverse slash	DF80	4020	1008	0402
0108	A1	tilde	9F08	1020	1008	1020
0110	E2	S	C064	9200	9200	924C
0118	E3	T	C080	0080	7E80	0080
0120	E4	U	C0FC	0200	0200	02FC
0128	E5	V	C0F0	0804	0204	08F0
0130	E6	W	C0FC	0204	1804	02FC
0138	E7	X	C082	4428	1028	4482
0140	E8	Y	C080	4020	1E20	4080
0148	E9	Z	C082	048A	10A2	4082
0150	6A	vertical line	4000	0000	EE00	0000
0158	6B	comma	4000	001A	0418	0000
0160	6C	percent	40C2	04C8	1026	4086
0168	6D	underscore	4001	0001	0001	0001
0170	6E	greater than	4000	0082	4428	1000
0178	6F	question mark	4040	8000	8A00	9060
0180	F0	0	C038	4482	0082	4438
0188	F1	1	C000	4200	FE00	0200
0190	F2	2	C042	8402	8802	9062
0198	F3	3	C084	0280	12A0	528C
01A0	F4	4	C008	1028	4088	7608
01A8	F5	5	C0E4	02A0	02A0	029C
01B0	F6	6	C00C	1220	5280	120C
01B8	F7	7	C080	0284	0890	20C0
01C0	F8	8	C06C	9200	9200	926C
01C8	F9	9	C860	9002	9408	9060
01D0	7A	colon	4000	006C	006C	0000
01D8	7B	number sign	4028	00EE	00EE	0028
01E0	7C	at sign	4038	4482	308A	403A
01E8	7D	apostrophy	4000	00D0	20C0	0000
01F0	7E	equal	4028	0028	0028	0028
01F8	7F	double quotation	4000	E000	0000	E000
0200	C0	opening brace	C000	106C	8200	8200
0208	50	ampersand	400C	52A0	5208	040A
0210	60	dash	4010	0010	0010	0010
0218	61	slash	4002	0408	1020	4080
0220	79	grave accent	4000	0080	4020	0000

Figure C-3. Standard EBCDIC Wire Image Table

ALTERNATE CHARACTER	*HEX CODE*	*PRINTED CHARACTER*	*GRAPHIC*
1	4A	Number Sign	#
2	4F	Exclamation	!
3	5A	Dollar Sign	$
4	5B		Ü
5	7B		Ä
6	7C		Ö
7	EO	Section Sign	§
8	4A	Open Bracket	⌐
9	5A	Close Bracket	¬
10	5F	Circum Flex	^
11	7C		a
12	EO		ξ
13	4A	Degree	°
14	5A	Section Sign	§
15	7B	Pound Sign	£
16	5A		€
17	7C	Section Sign	§
18	4A	Pound Sign	£
19	5B	Yen Sign	¥
20	EO	Dollar Sign	$
21	4A	Section Sign	§
22	5A	Intern Curr	¤
23	5B		Å
24	EO		É
25	7B		Æ
26	7C		Ø
27	4C		ξ
28	7B		Ã
29	7C		ð
30	5B	PTS	PT
31	7B		Ñ
32	4A		É
33	5B		ξ
34	5A		/
35	A1		° °
36	EO		ь
37	7B		ð
38	7C		Ã
39			
40			

Figure C-4. Alternate Characters for the 4974—Selectable by Program

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